AIR ENGINEERING

JANUARY, 1960

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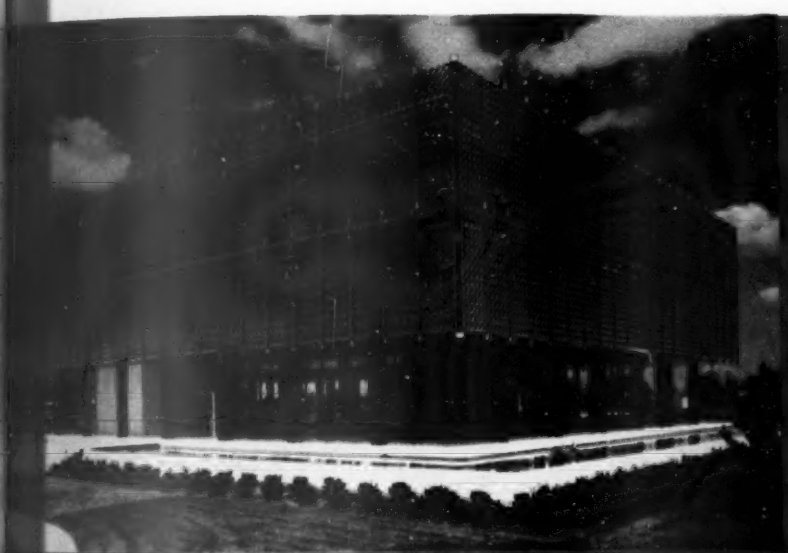
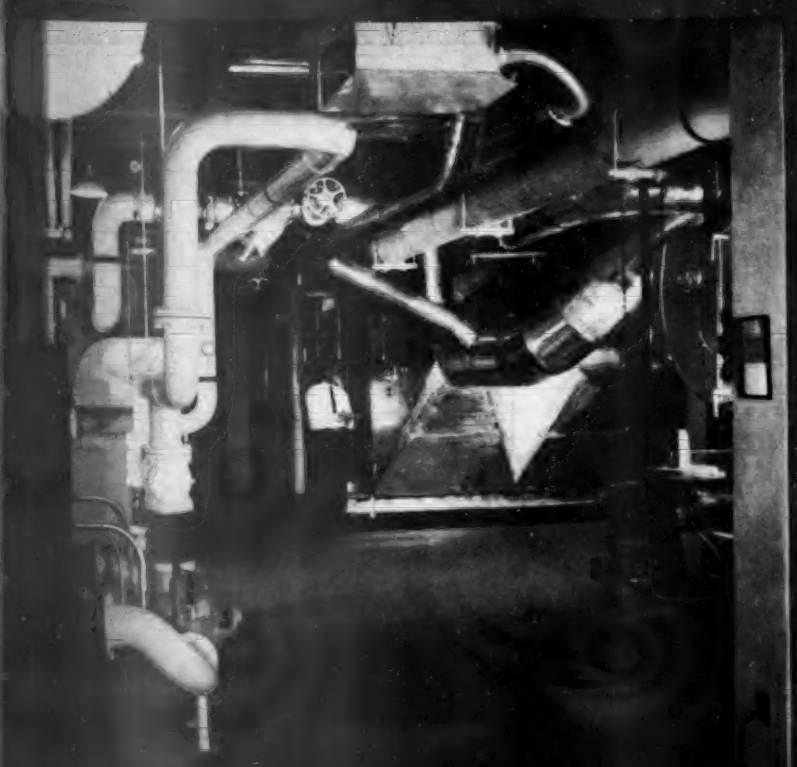
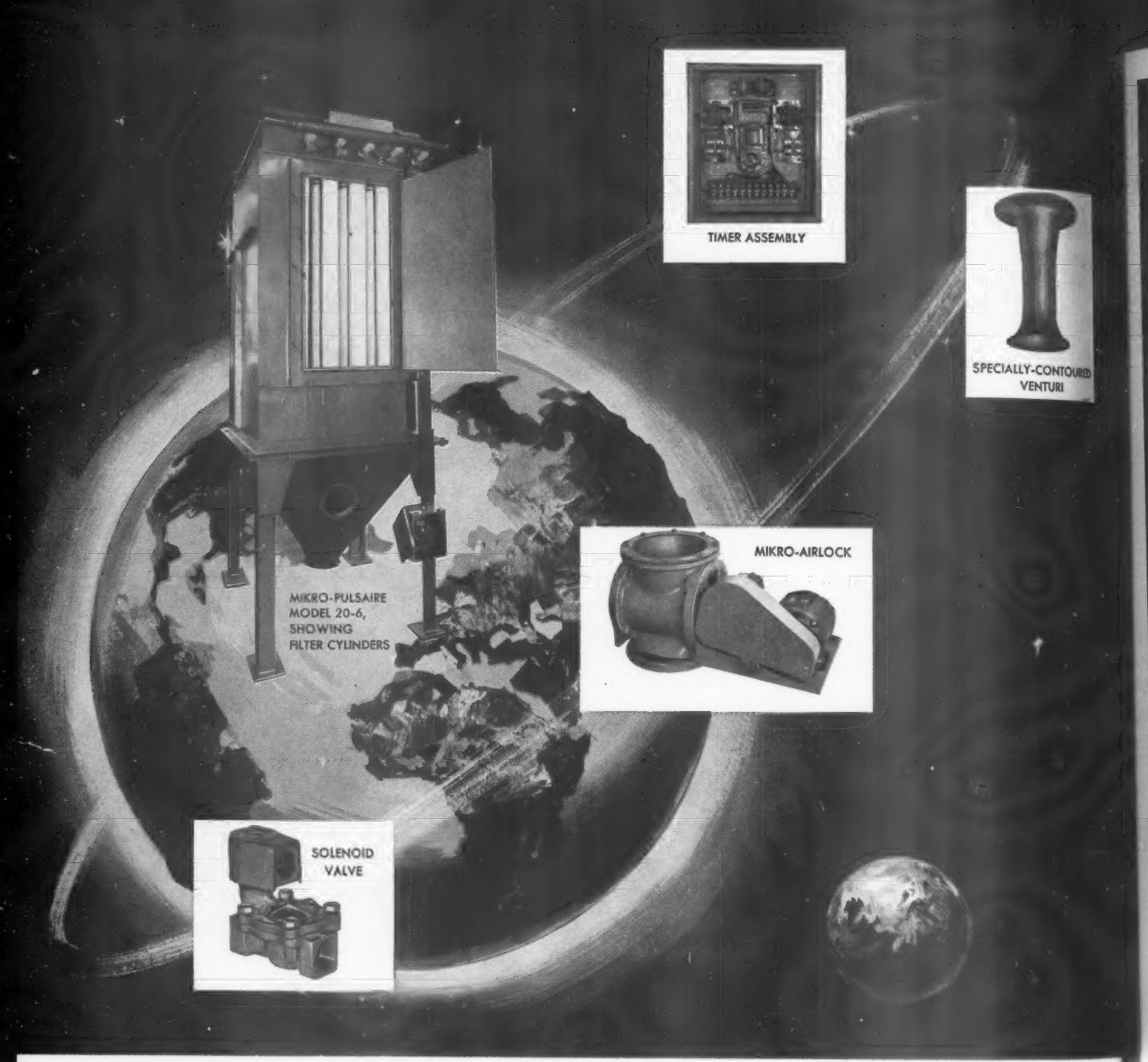
AIR POLLUTION CONTROL • AIR MOVING • AIR CONDITIONING

- *Gas vs Electric Heating* • *Guide To Fan Selection*
- *"Fingerprinting" Air Pollutants* • *Safeguarding Plant Air*
- *All About Respirators* • *Facts On Dust Collectors*
- *Dallas Hosts Southwest's Biggest Air Conditioning Show*
- *15 WAYS TO CUT BIG BUILDING HEATING-COOLING COSTS*



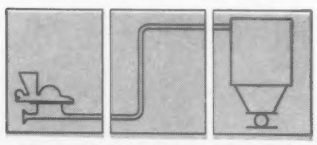




THE ORBIT OF ACCEPTANCE . . .

It's still young enough to be called "new" . . . but the MIKRO-PULSAIRE Collector is actually a veteran that's proving itself on nuisance dust and air pollution control jobs all over the world. If you're looking for assurance of around-the-clock recovery with constant low differential pressure, full-time automatic cleaning and absolute minimum maintenance, you'll find it in the MIKRO-PULSAIRE! It's a simplified unit, as the basic components above will show you . . . and yet it delivers a filtering efficiency of 99.9% plus on a wide variety of harmful or noxious dusts. Engineered for economy, the exclusive Mikro jet-action principle eliminates gears, cams, chains and other high replacement-cost parts inside the housing, and guarantees longer bag life, as well. There's a MIKRO-PULSAIRE for every nuisance dust problem, including new modular construction units with capacities from 20 cfm to any known requirement. Bulletin 52A, which is yours for the asking, tells the complete story.

PROCESSING SYSTEMS



GRINDING CONVEYING COLLECTING

SPAN THE GLOBE

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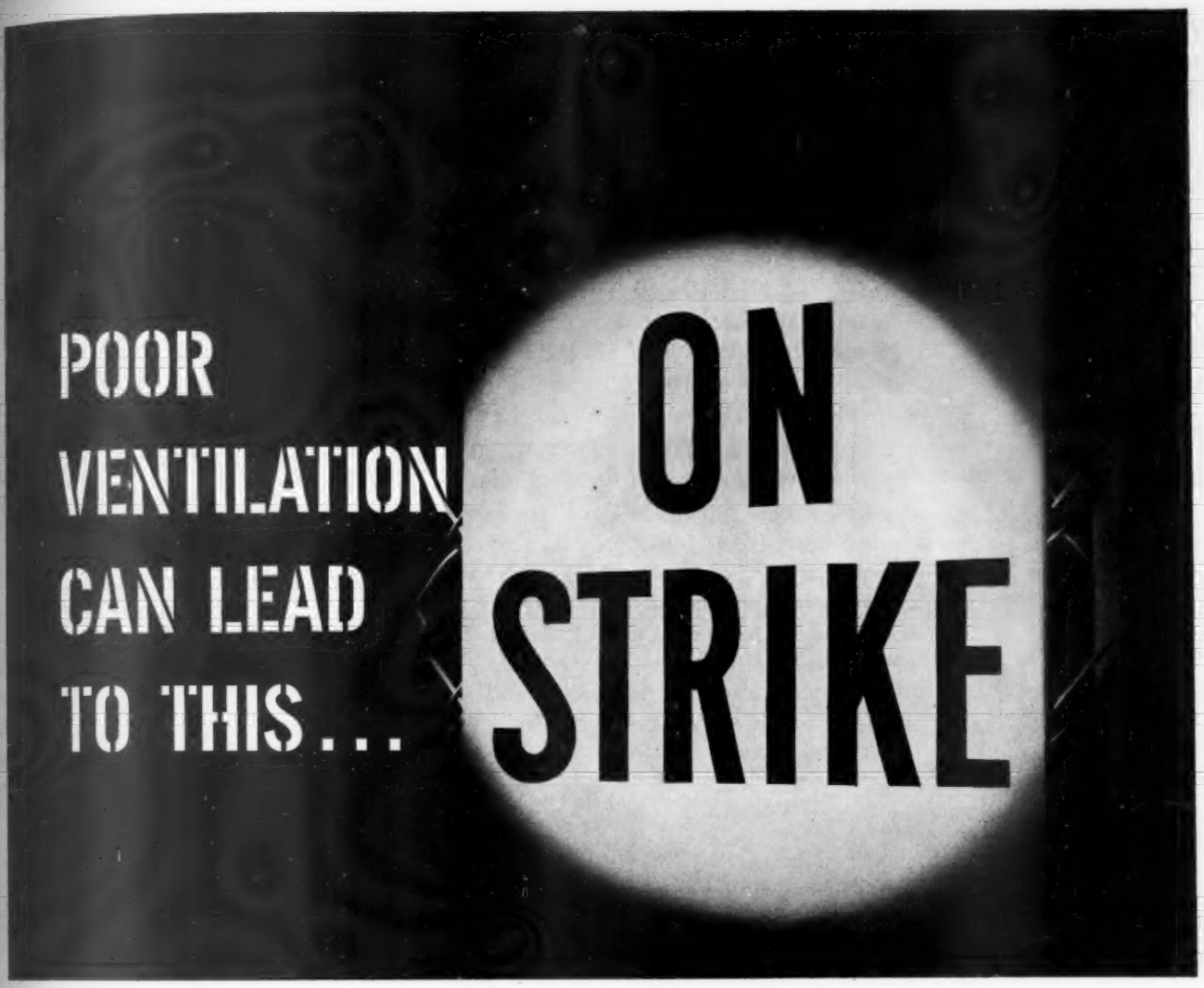
Pulverizing Machinery Division • Metals Disintegrating Company, Inc.
1 Chatham Road • Summit, New Jersey

REPRESENTATIVES throughout the United States, Continental Europe, British Isles, Canada, Mexico, Central and South America, West Indies, South Africa, India, Japan, Philippines, Australia and New Zealand.

MANUFACTURING FACILITIES: United States, Canada, Continental Europe, British Isles.



Hartzell ventilation can help prevent it

Bad ventilation is seldom the sole cause of a labor dispute, but it's often a contributing factor. Unpleasant working conditions are bad for morale. Smoke, heat and fumes cause discomfort . . . and discomfort breeds discontent.

Effective control of heat, smoke and fumes, can do wonders for morale . . . and for production efficiency. Good working conditions mean good spirits . . . and a minimum of accidents, errors and absenteeism.

Whether you're concerned with the operation of an existing plant or the design of a new one, Hartzell's complete line includes the equipment you need to insure effective ventilation. Ask your nearby Hartzell representative for details. If you don't know him, drop us a line for his name and address.

here's a complete line of air moving equipment designed and built specifically for industry

Other famous Hartzell products include controllable and full feathering propellers for light aircraft, crop drying equipment and farm ventilating fans.

HARTZELL PROPELLER FAN COMPANY • **66 Thomas Blvd. Piqua, Ohio**
Div. of Castle Hills Corp. A Member of AMCA Engineering Offices in Principal Cities

Buell Announces Expansion

The Buell Engineering Company has announced purchase of all of the stock of the Northern Blower Company of Cleveland, in a transaction that entailed more than $2,500,000.

Buell, manufacturers of air cleaning equipment, expands its line to include Northern Blower bag-type dust collectors. L. A. Eiben, president of Northern Blower, will continue in that capacity.

Westinghouse Invades Yankee-land With Heat Pumps

Sales of heat pumps, hitherto concentrated south of the Mason-Dixon Line, are being expanded into northern markets, according to Raymond K. Serfass, general manager of Westinghouse's air conditioning division.

Expansion will concentrate in those areas where electric rates have been established to encourage use of electric heating. (See page 20 for article on electric heating).

Heat pump capacity for cooling and economical mild weather heating will be clearly defined, so sufficient supplementary heating can be installed to handle design heating load.

Tax Relief Bills on Air Cleaning Equipment Under Consideration

Two House bills designed to provide amortization deduction for air pollution control facilities have been referred to the House Ways and Means Committee.

H.R. 7566 provides for "a deduction for amortization of the adjusted basis based on a period of 60 months. Adjusted basis is for determining gain. The Bill is a proposed amendment to the Internal Revenue Code, section 169, part VI, subchapter B, chapter 1, relating to itemized deduction for individuals and corporations.

H.R. 332 is substantially similar to H.R. 7566, with amortization deduction "an amount, with respect to each month of such period within the taxable year, equal to adjusted basis of the air purification facility at end of month divided by number of months remaining in period."

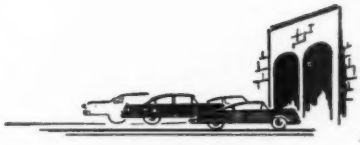
Air purification facility is defined as "any device, facility, land, building, machinery or equipment, or any part thereof, used to control atmospheric pollution or contamination by removing, altering or disposing of atmospheric pollutants and contaminants from any type of manufacturing process which was completed after Dec. 31, 1958."

Harvester Budgets $750,000 For Air Cleaning Equipment

International Harvester Company plans to spend $750,000 to clean air at its Louisville, Ky., plant, according to plant manager C. E. Reimers. A $250,000 dust collector has already been installed on one of the plant's three pairs of foundry cupolas. Duplicate units are planned for the other cupolas.

New Trade Association In Gas Cleaning Industry Formed

A new trade organization, the Industrial Gas Cleaning Institute, Inc., has been formed by representatives of leading manufacturers of gas cleaning equipment. The new non-profit group has elected John T. Doyle, Thermix Corp., as its first president. (See page 12 for a complete report on the new association.)

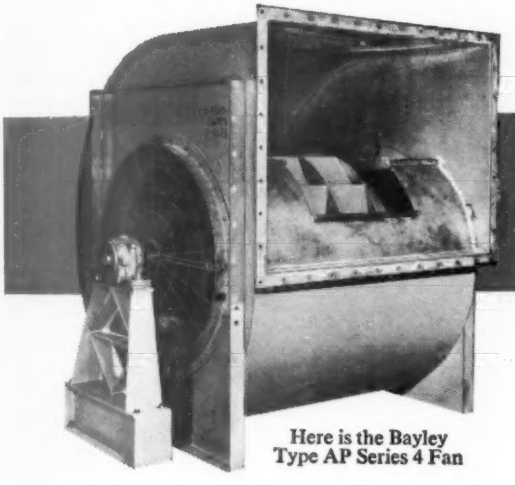


In Pittsburgh's new Fort Pitt Tunnel, Bayley fans were chosen for ventilation

Bayley fans were chosen for placement at both ends of the new Fort Pitt Tunnel.

Why Bayley? The engineers might have considered the 35 years of trouble-free service delivered by Bayley fans in the Liberty Tunnel in Allegheny County.

There are ten Bayley Type AP Series 4 fans to be installed in the Fort Pitt Tunnel.



Here is the Bayley Type AP Series 4 Fan

Here is the new Fort Pitt Tunnel

Four Bayley Type AP Series 4, DW-DI, 108¾" wheel diameter fans to be installed at each end of the tunnel.

ONE END: Four fans—326,600 CFM, each at 3.0" S.P., 294 RPM, Motors 200 HP, chain drive.

OTHER END: Four fans—264,500 CFM, each at 1.99" S.P., 239 RPM, Motors 100 HP, chain drive.

ONE TUNNEL EXHAUST FAN AT EACH END on Emergency Standby—DW-DI, 98¼" wheel diameter, 300,000 CFM, each at 1.5" S.P., 320 RPM, Motors 150 HP, direct drive.

When you want a job well done, it's good sense to call Green.

Green-Bayley BLOWER DIVISION

THE GREEN FUEL ECONOMIZER CO., INC.

BEACON 3, NEW YORK

LENNOX

The Lennox Living Laboratory: This $50,000 school has been built by Lennox Industries, Inc. in Des Moines, Iowa to carry on research in the field of school classroom heating, ventilating and air conditioning. Extensive research and testing is carried on continuously, both with and without students present in the classrooms.

GAS *and* **LENNOX** *can provide your schools with the finest in fresh air heating and ventilating...*

at lower operating and building costs

This new Gas system automatically draws in fresh air from outside . . . warms, cleans, and circulates air quietly and evenly throughout the school.

It's hard to believe, yet 65¢ per square foot was the complete cost of installing a Gas-fired Lennox Comfort Curtain System in the Potosi, Missouri, High School – including automatic controls, ductwork, labor – everything.

This is unusually low, even for the Comfort Curtain, but costs of $1.03 in Indiana; $1.15 in Montana; and $1.12 in South Dakota were *usual and typical* of the amazing savings offered by a Lennox Comfort Curtain System using Gas.

Money saving, safe Gas units are being installed in thousands of schools across the country. If you have specific questions, your local Gas company or a Lennox specialist—or both—will be available to assist the architects and engineers to illustrate how this equipment can best be applied to any specific school plan. Check the facts about Gas and you'll see – modern Gas heating out-performs all other fuels.

Call your local Gas company or write to Lennox Industries, Inc., 1701 East Euclid Ave., Des Moines 5, Iowa. *American Gas Association.*

Dust Control is a job for Engineers

The "rule of thumb" methods of the inexperienced, or the "engineering rules" of an experienced design, fabrication, and installation firm — which will you select for your dust control problems?

Kirk and Blum offers you . . .

ENGINEERING — a staff of qualified engineers with proven ability to solve your dust control problems.

RESEARCH—continuous research on full scale equipment, to develop the most efficient systems.

EXPERIENCE—over 50 years of dust control service.

Every Kirk & Blum installation is based on a complete service: Design — Fabrication — Installation, backed by K & B's acceptance of One Undivided Responsibility for the system to assure your satisfaction.

On your dust control problem consult Kirk and Blum, craftsmen in dust control, where fine craftsmanship is appreciated. The Kirk & Blum Manufacturing Company, 3130 Forrer St., Cincinnati 9, Ohio.

KIRK & BLUM DUST CONTROL SYSTEMS

Letters

Article Revives Interest In Air Curtain

Editor:

In the November, 1959 issue of your magazine, a brief article appeared in your Newsletter section regarding purchase of American Air Curtain Corp. The article revived previously abandoned discussions with reference to the possibility of installing an air curtain system in the shipping area of our plant. We would be very interested in any information you could furnish.

There are several pros and cons that always arise as to the benefits derived from an air conditioning installation. I know there are several good studies that have been published regarding this item, but have never been able to pin any of them down. If you have any of these on file, I would appreciate a copy. If not, maybe you could put us in touch with an agency who could furnish that type of information.

L. M. Bachinski
Methods Engineer
Albion Malleable Iron Co.
Albion, Michigan

Editor:

I was especially interested in the direct gas fired make-up air heater write-up (page 26, Sept. issue).

Edward E. Gygax
President
Gygax Sales & Equipment Co.
St. Louis, Mo.

Editor:

Would greatly appreciate copies of Part II or Part III of "Primer on Factory Ventilation." They appeared in Sept. and Oct. issues, which I did not receive. Three year subscription has been ordered.

J. O. Ames
Plant Engineer
Universal Foundry Co.

Editor's Note:

A very limited number of copies of this four part series on factory ventilation are available. First come, first served.

(Please turn to page 8)

Use Communications Center, page 35, for requesting more information about articles, advertised products, literature, etc.

AIR ENGINEERING

VOL. 2, NO. 1

JANUARY, 1960

DEDICATED TO THE SCIENCE OF AIR POLLUTION CONTROL
AIR MOVING • AIR CONDITIONING

FEATURES

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A consulting engineer makes point-by-point comparison in two actual buildings

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Instruments For Detecting Industrial Air Contaminants 27
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COVER

Striking new building on front cover is Detroit sales office of Reynolds Metals Co. Designed by Minoru Yamasaki as a showcase for aluminum, it will be subject of article on building's unusual heating-cooling system in a future issue.

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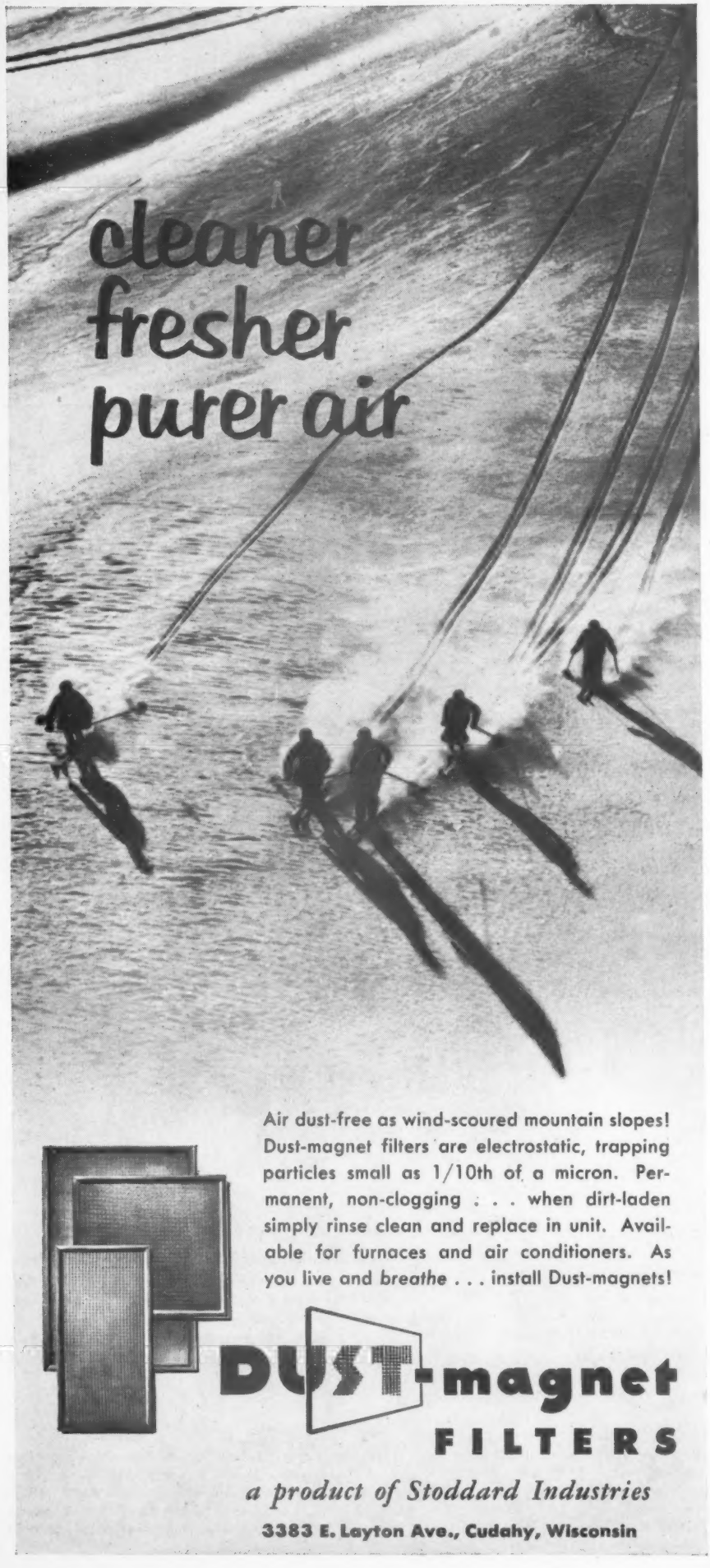


Air dust-free as wind-scoured mountain slopes! Dust-magnet filters are electrostatic, trapping particles small as 1/10th of a micron. Permanent, non-clogging . . . when dirt-laden simply rinse clean and replace in unit. Available for furnaces and air conditioners. As you live and *breathe* . . . install Dust-magnets!

DUST-magnet
FILTERS

a product of Stoddard Industries

3383 E. Layton Ave., Cudahy, Wisconsin

Letters

(Continued from page 6)

Editor:

It is with the greatest interest and pleasure that I receive my copy of AIR ENGINEERING. An adequate publication has been long overdue in this field.

When I was approached by my Administrator for my opinion as to the worth of your publication, I told her that I thought it should be a "must" on our subscription list. This field is of increasing importance to every growing institution.

Melvin C. Dunavant
Richmond Eye Hospital
Richmond, Virginia

Editor:

In the November, 1959 issue, under "Pollution Complaint$ (page 15) mention was made concerning Standard Dredging Company's solution to a problem of neutralizing hydrogen sulfide fumes. I am faced with a similar problem, and would appreciate any information concerning the methods used.

E. J. Scrip
Project Engineer
G. D. Searles & Co.
Chicago 80, Illinois

Editor:

Please send a copy of your recent issue which included the article by Mr. Meckler of Toledo (page 18, Nov. issue) on a "Multi-dewpoint Conditioning System" to T. Marsailles, R. R. Donnelley & Sons, Chicago. We had occasion to discuss this article in going over one of Donnelley's recent air conditioning projects.

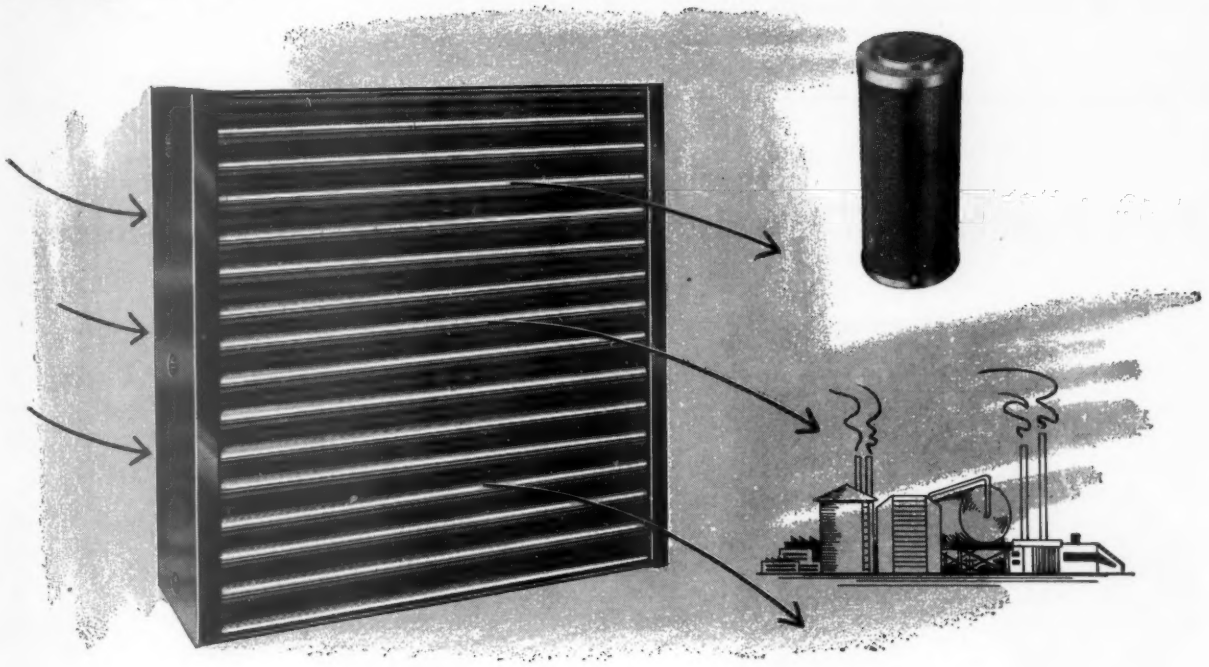
J. M. Groskopf
Toledo Office
The Trane Company
Toledo, Ohio

Editor:

The article by C. O. Wood on page 29 of November, 1959 refers to a problem that is not understood by many sheet metal contractors today. Much field trouble is experienced due to contractor's lack of knowledge or the availability of easily understood design principles.

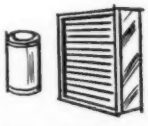
K. D. Woundy
Mgr., Technical Service Dept.
Non-Franchised Products
Worthington Corporation
Harrison, N. J.

this is DOREX



27 years of Research, Development, and Application make it the most effective, economical method of AIR RECOVERY and ODOR CONTROL

WHAT DOREX IS . . .



Dorex equipment is designed in two basic types—C Cells and H Canisters—Dorex acts exactly like a gas mask, using activated carbon to absorb air-entrained odorous, gaseous, and vaporous irritants and impurities. As a direct result of the carbon's highly effective purging action, stale and/or contaminated air is purified and reconverted to its original healthful freshness, ready for sanitary re-use in air conditioning systems. The Dorex process eliminates the biggest obstruction to maximum economy in air conditioning.

HOW DOREX WORKS . . .

Dorex efficiently solves the several air pollution problems menacing business, industry, and the general public: purification of severely contaminated intake air (smog); purification of recirculated air; purification of contaminated exhaust air.

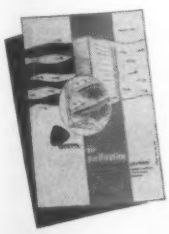
WHERE DOREX IS USED . . .

Dorex is used throughout business and industry, in combination with air conditioning and ventilating systems . . . in office buildings, department stores, food processing plants, distilleries, electrical and electronics plants, atomic energy labs, paper factories . . . virtually anywhere that polluted air creates severe problems of offensive odor, equipment corrosion, and toxic atmospheric conditions.

WHY DOREX IS THE MOST EFFECTIVE

Dorex engineers always select the type of carbon that years of Connor research and experience have proved is most successful in different given situations. There is *no single all-purpose* type of activated carbon that can be applied successfully in all air recovery and air purification situations.

CONNOR... for Constant Comfort Conditions



Request—on your letterhead, please—copies of Dorex Bulletin 108A and the authoritative air purification textbook available only from Connor, "Air Conservation Engineering".

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air recovery

Mine Safety Appliances Company

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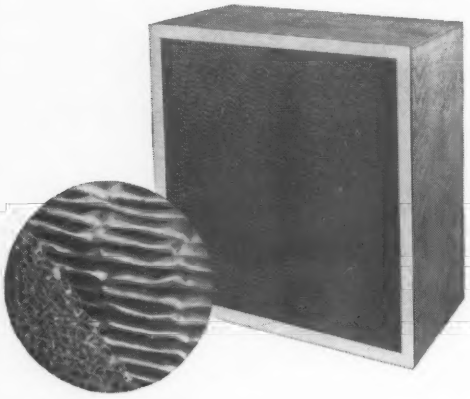
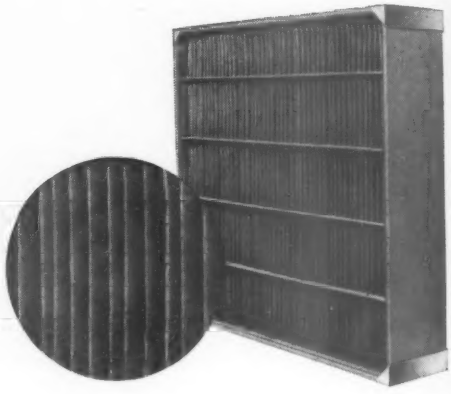


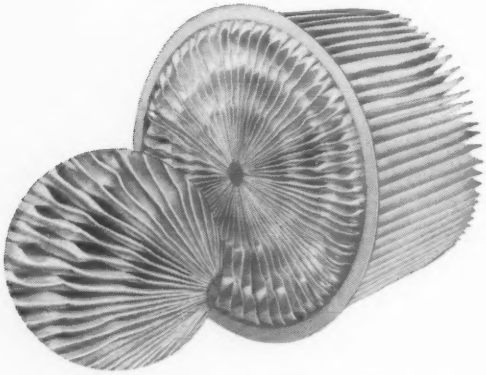
M-S-A® UltraAire* Space Filter

Lightweight, fire-resistant, unusually strong, and ideal for high humidity service. Individually pretested and proved at least 99.97% efficient in removing particles of 0.3 micron diameter.



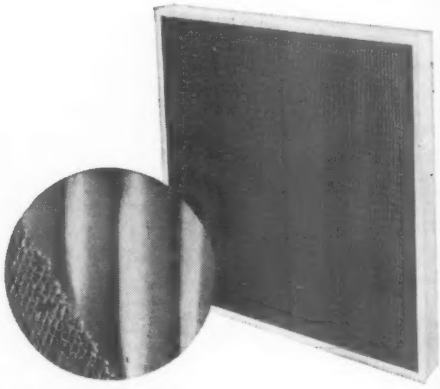
M-S-A® Dustfoe* Space Filter

Offers the efficiency of an Electrostatic Precipitator without the high cost and without the possibility of arcing "blow-off." 85-95% certified efficiency on NBS Atmospheric Air Dust Stain Rating.



M-S-A® Cylindrical-Type UltraAire* Space Filter

Honeycomb-type fold without separators is admirably suited to cylindrical element construction. This shape is preferred for pressure systems and round ducts. Easy to handle. Inexpensive to ship.



M-S-A® Air-O-Kay* PreFilter

Impingement type panel prefilter which can be used oiled or dry to remove lint and other large airborne particles from the atmosphere. 60-70% certified efficiency on NBS Stain Rating.

*Trademark

Write for illustrated technical bulletins on M-S-A Space Filters related to your particular system problem. Ask an MSA Representative for system recommendations. Mine Safety Appliances Company, Pittsburgh 8, Pa., Phone: CHurchill 1-5900.

Other Fluid Purification Equipment includes catalytic filters for jet aircraft cabin air; air separation plants; inert gas generators; space capsules; bomb shelters; air line filters; jet fuel and hydraulic fluid purification.

AIR ENGINEERING

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EDITORIAL:

Khruschev, Here We Come—With Air Conditioned Schoolrooms!

WHEN THE first Sputnik rocketed there arose a cry, almost as high as its orbit, all around the U.S.A., to wit: "American education has failed!"

Science teachers complained that their equipment was insufficient, and their pay microscopic, compared to the offerings of private industry. Parents, suddenly alerted, made noises also.

Too few schools can attract and keep high grade men to teach science, it was argued. "We don't graduate enough mathematicians from our institutions of higher learning" . . . and so on, and so forth *ad infinitum.*

At long last there comes a positive suggestion, following all these negatives.

Latest proposal for "catching up with the Russians," if indeed this is the proper phrase to describe the situation, simply concerns altering an attitude: Treating our children as handsomely as we grown-ups treat ourselves.

Nearly 30 percent of U.S.A. citizens live in the South Atlantic, East South Central and West South Central States—areas where high heat and humidity sap the energy and mental agility of our youngsters from early spring until comparatively late in the fall.

Perhaps we should stop treating our children in grade school, high school, and college *as second class citizens* when it comes to indoor climate. Let them achieve their utmost efficiency in properly heated and cooled school rooms! Allow them to breathe clean air!

Taxpaying adults treat themselves to controlled indoor climate conditions (and rightly so) for pleasure and profit—wherever they work, eat, sleep, or play.

Our offices are comfortably cooled. And warmed and air-purified. Thus, increased efficiency is gained from all employes who are doing work which demands top mental and physical abilities.

But what do we do for the citizens of the future? Those lads and lassies who must bend their brains, and lend their energies to "catching up with the Russians"—are we treating them fairly?

We don't intend to stir up angry correspondence by suggesting a 12-month school year, even to compete with the Russians. As taxpayers, however, we

(Please turn to following page)

NEWS of the Industry

Air Distribution System Plays Key Role In New 'AromaRama' Scented Movie

"AromaRama" . . . a motion picture in which the viewer smells what he sees, bowed recently in New York City.

While the first full-scented movie, "Behind the Great Wall," brought gasps of astonishment from viewers, those responsible for this new development in movie making gave full credit to advances achieved in the art of air engineering.

During the showing of the film no less than 72 scents are wafted to the olfactory organs of the audience, the scents keyed to scenes that would produce the odors if one were actually at the spot shown on the film.

The air distributing system and air treating system must cleanse all the air in the theater of odors from one scene well before new odors from new scenes are introduced. With scents ranging from the tangy one of an orange being sliced, a tiger in the jungle and the acrid odor of exploding firecrackers, some expert effort in the conditioning system is obvious.

"AromaRama" was developed in part by Bernard H. Lepselter, Admags Engineering Co., New York City air conditioning contractor; and officials of Statronic, odor control equipment. Odors are compounded by Rhodia, Inc., French perfume makers.

Odors reach theater occupants in the following manner: On suction side of cooling system blower, scents are introduced as an aerosol. Aerosol spray release is actuated by impulses from the film sound track. On suction side of the blower, ahead of the odor atomizer, are permanent type filtering media, then the Statronic odor control device, which produced a negative ionization effect through a grid-like structure fitted tightly into ductwork. No ozone is created, all faint traces of the scent are removed as air is returned. Some outside air is bled into the system.

Major problems were to blanket theater evenly with the odor, quickly remove odor after scene is over, and introduce new odor without any odor lag from previous scene.

Full details on the air distribution, odor cleansing and air conditioning system in the "AromaRama" movies are being withheld by the system's owners, in order to protect design concepts they feel are possibly unique. However, it is claimed that any existing central station air conditioning system with reasonably good air supply and return facilities can be used.

Form New Industrial Gas Cleaning Institute

A new trade organization, the Industrial Gas Cleaning Institute, Inc., has been formed by representatives of leading manufacturers of gas cleaning equipment. The new non-profit group has elected John T. Doyle, The Thermix Corp., Greenwich, Conn., as its first President.

Other officers elected at the organizational meeting were L. L. Andrus, Wheelabrator Corp., Mishawaka, Ind., Vice President; and John G. Liskow, American Air Filter Co., Louisville, Ky., Treasurer and Temporary Secretary.

Directors elected include W. O. Vedder, Pangborn Corp., Hagerstown, Md.; Robert Kopita, Peabody Engineering Corp., New York, N. Y.; D. L. DeVries, Koppers Co., Baltimore, Md.; L. D. Eiben, The Northern Blower Co., Cleveland, Ohio; R. R. Leech, The Ducon Co., Mineola, N. Y.; Hugh Mullen, Buell Engineering Co., New York, N. Y.; W. W. Moore, Research-Cottrell, Inc., Bound Brook, N. J.; and Robert Stewart, Western Precipitation Corp., Los Angeles, Calif.

Industrial Gas Cleaning Institute has as its purposes to promote the interests of manufacturers of industrial gas cleaning equipment; to provide for improved trade practices among its members; to

Editorial (Cont.)

Krushchev Here We Come . . . With Air Conditioned Schools

(Continued from preceding page)

can get added revenue from our investment in school buildings by working these civic centers all year round for adult education, community meetings, and dozens of other worthy neighborhood activities.

By air conditioning schoolrooms from kindergarten to college, we could provide the finest facilities for the acquisition of knowledge, and for the democratic use thereof, for all citizens evermore.

Johnny, whether, he's a youngster in grade two or a senior in college, never should have to be drugged by heat and humidity or impure air. While he prepares for HIS future—which will enable us to maintain our challenged national and international supremacy —let him study in comfort!

Prof. Ellsworth Huntington of Yale university collected data, over a span of some 30 years, on many types of mental work related to climatic conditions. Statistically he has proved that students suffer their lowest marks when they take tests in hot, humid air conditions.

It's high time that we change the status of our children in school from second class citizens (in terms of the climate we provide for them) . . . to the same first class status in which we indulge ourselves.

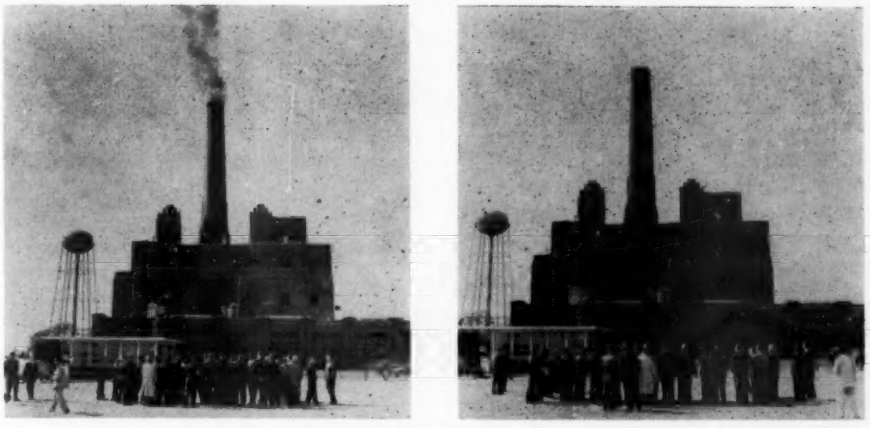
The art of air conditioning, plus the science of Air Engineering, can do it! Moreover, the cost per classroom is remarkably low. ▲▲

provide a greater interest among the public in the manufacturing, engineering and public safety as they relate to industrial gas cleaning; to perfect the standards of design and operation of gas cleaning equipment; to encourage the development of the science and art of engineering as related to industrial gas cleaning equipment and/or device; to perfect the standards of testing in the various fields served by industrial gas cleaning equipment; to collect and disseminate lawful information of value to members of the Institute, the industry, and the public regarding the several products of the industry and their application to industrial gas cleaning; to cooperate with and assist all governmental departments, agencies and bodies in regard to matters affecting the industry.

To Publish Bi-Monthly

The *Journal of the Air Pollution Control Association*, a technical publication, will expand to a bi-monthly beginning with the February, 1960 issue, the Air Pollution Control Association announced recently.

Smoke . . . . . Abatement



Interested city, state, and Federal air pollution officials gathered during "Cleaner Air Week" last October at the Western Electric Co. plant in Baltimore to watch a practical demonstration of smoke control equipment. With no control (left) smoke from the plant's coal-fired boilers passes unchecked out of the stack. After the two Koppers electrostatic precipitators, on each side of the stack, were activated for only 39 seconds, the stack resumed its normal, smoke-free appearance (right).

Dr. Greenburg Resigns New York City Post

Dr. Leonard Greenburg, New York City's first commissioner of air pollution control, will resign Jan. 8 to become a professor of preventive medicine at Yeshiva University.

Dr. Greenburg has held the post through repeated appointments since 1952. No successor to Dr. Greenburg had been named at press time.

(Please turn to following page)

Airsan Viro Crimp
HIGH VELOCITY AIR FILTERS

VIRO CRIMP MEDIA
has special Hemmed Edges for strength and safe, easy handling. No cuts! No scratches! No filter surface damage.

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Write for details!

NEWS of the Industry . . .

(Continued from preceding page)

Big System Cooling May Hit $600 Million

Installed value of "big system" air conditioning in office buildings, apartments, hotels, and industrial plants during 1959 may be more than $600 million, estimates the Air-Conditioning and Refrigeration Institute.

This represents a gain of about 10% over the $550 million in 1958 and almost 60% over the 1954 installed value of $379 million.

These figures represent equipment in place rather than the value of manufacturers' shipments, and include cost of installations, ductwork, grilles, and other elements.

Manufacturers of system components feel that the potential for this type of equipment is great, says ARI, particularly in the industrial field. Only about 10 to 15% of U. S. factories are air conditioned today.

Crane Set To Acquire National-U. S. Radiator

Board of directors of Crane Co., large plumbing wares manufacturer, has voted to acquire the operating assets of National-U.S. Radiator Corp., and the Swartwout Corp.

National-U.S. Radiator makes heating and air conditioning equipment and Swartwout electronic controls for the petroleum and chemical industries.

National-U.S. stockholders are expected to vote this month on the proposed sale. Offered price is $15 million cash. Present management would be continued.

Buensod-Stacey May Become Aeronca Div.

Directors of Buensod-Stacey, Inc. and Aeronca Mfg. Corp. have agreed to merge, with Buensod-Stacey to become a division of Aeronca. Shareholders of both firms are to vote on the merger in February.

Buensod-Stacey, pioneer in the development of high pressure dual duct air distribution systems, will continue to operate as a self-contained division with President Milton S. Smith to remain as general manager and become a vice president and director of Aeronca.

Find Smoke, Smog Hurt Respiratory Tract

Two reports from the University of Southern California School of Medicine give evidence that cigarette smoke and natural and artificial smog and their components affect the respiratory tract in three ways.

They slow the flow of mucous stream, change physical properties of mucous, and decrease the whip-like action of cilia.

These effects impair functioning of the mucous and cilia to prevent accumulation of foreign matter on lining of respiratory tract.

One report suggests that impairment of this function by smoke from cigarettes and other forms of air pollution may permit abnormal retention of cancer causing agents there.

The other report declared that Los Angeles smog aggravates breathing difficulties of persons suffering from emphysema — a condition which impairs efficiency of the lungs.

ASME Preparing List Of Pollution Projects

The American Society of Mechanical Engineers Task Group on Research in Air Pollution is again undertaking a compilation of Active Air Pollution Research Projects.

The inventory will consist of research projects which were active during 1959, and will include the organization and the researcher.

The Task Group sent out questionnaires in December.

All organizations and personnel who wish to be included in the compilation of active air pollution research projects should communicate with: Austin Heller, Chairman, Task Group, Air Pollution Research, American Society of Mechanical Engineers, 29 West 39th St., New York 18, N. Y.

Join To Develop, Sell Solar Energy Devices

Hupp Corp., air conditioning and heating equipment manufacturer, and Curtiss-Wright Corp., aircraft manufacturer, have agreed on joint development and sales of solar energy devices. Curtiss-Wright has been active in developing equipment to use solar energy in heat storage and cooking.

Pollution Complaint$

Salt Lake City—New $200,000 dust collector ends air pollution problem from kilns at Portland Cement plant. Centrifugal, mechanical, and bag type collectors were used.

• • •

Cleveland—Foundries in southwest area of city blamed for smoke and fumes by citizen's committee and city Air Pollution Division. Darling Co. plans installation of $10,000 equipment to end offensive odors.

• • •

Louisville — Air Pollution Control Board warned Gold Proof Elevator, 14th and Ormsby, that it has 120 days to curb amount of dust emitted; and warned Palmer Asbestos and Rubber Corp., 146 St. Matthews St., court action will be sought if odors not reduced when plant reopens March 1, 1960.

Hawaii — On Oahu, two new cement plants will have electrostatic precipitators (Western Precipitation).

• • •

Pittsburgh — Jones & Laughlin new steel making facilities will have electrostatic precipitators on the two oxygen steelmaking furnaces, and the three 220-ton open hearths. Gases from open hearths and oxygen furnaces will be combined and cleaned in same units to reduce costs. (Western Precipitation).

• • •

Lorain, Ohio—At National Gypsum Co. partially completed plant, about $8,000 damage from fire in dust collector in rock dye building.

• • •

Chicago—U.S. Steel Corp., South Works, an electrostatic precipitator for cleaning blast furnace gas. Unit will handle 53,200 cfm, be 95 percent efficient. (Koppers Co.).

Meetings, Courses, Expositions

U. S. Public Health Service course in "Medical and Biological Aspects of Air Pollution," *Robert A. Taft Sanitary Engineering Center, Cincinnati, Jan. 11-15.*

Society of Automotive Engineers, Inc. annual meeting, *Hotel Statler, Detroit, Jan. 11-15.*

Three day conference on "Man and His Environment: The Air He Breathes," *University of California School of Medicine, San Francisco, Jan. 16-18.*

11th Plant Maintenance and Engineering Conference and Show, *Convention Hall, Philadelphia, Jan. 25-28.*

2nd Southwest Heating and Air Conditioning Exposition, *Memorial Auditorium, Dallas, Texas, Feb. 1-4.*

American Society of Heating, Refrigerating, and Air-Conditioning Engineers, semi-annual meeting, *Hotels Baker and Adolphus, Dallas, Texas, Feb. 1-4.*

First Instrument - Automation conference and exhibit by Instrument Society of America, *Rice hotel and Sam Houston Coliseum, Houston, Texas, Feb. 1-4.*

U. S. Public Health Service course in "Microscopic Analysis of Atmospheric Particulates," *Robert A. Taft Sanitary Engineering Center, Cincinnati, Feb. 15-26.*

Ninth annual Industrial Ventilation Conference, *Kellogg Center, Michigan State University, East Lansing, Mich., Feb. 15-18.*

Air Pollution Control League of Greater Cincinnati 54th annual meeting, *Auditorium, Cincinnati Public Library, Cincinnati, Feb. 17.*

American Institute of Industrial Engineers, Detroit chapter's third annual winter conference. Theme: "Practical Approach to Industrial Engineering." *Statler Hilton hotel, Detroit, Feb. 18-19.*

U. S. Public Health Service course on "Atmospheric and Source Sampling," *Robert A. Taft Sanitary Engineering Center, Cincinnati, April 4-15.*

American Chemical Society, 137th national meeting, *Cleveland, April 5-14.*

American Society of Industrial Hygiene annual meeting, *War Memorial building, Rochester, N. Y., April 25-28.*

BHC Forms Div. To Push Industrial Hydronics

Promotion to sell hydronic heating and cooling in the commercial and industrial fields as well as residential will be launched this year by the Better Heating-Cooling Council.

Organizers of the new commercial and industrial division of the Council pointed out that the hydronics field has a big stake in protecting its interests in the commercial and industrial market where it has the major share of the business but where other forms of heating and cooling are making strong drives for a bigger cut of the business.

The hydronics industry is looking for its biggest year in 1960.

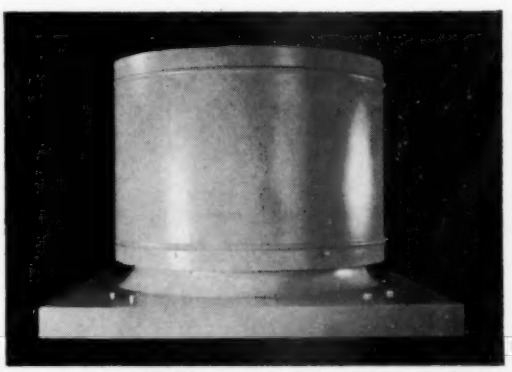
At the same time, E. O. George, vice president of Detroit Edison Co., declared that the electric utility industry stands ready to support any and all kinds of heating applications, whether the installation is resistance room heating, heat pump, or some other method.

"We don't care what the system is," he said, "just so it does the job and just so it's electric."

NEW AXIAL ROOF VENTILATORS BY WESTERN

The Westernaire® Low Silhouette Hooded Exhaust Ventilator

The Westernaire® Low Silhouette Vertical Exhaust Ventilator



Above: A high efficiency power unit in a low, weather-proof housing. For both commercial and industrial use. 360 degree near horizontal discharge. Aerodynamically correct spun housing. Heavy guage steel, aluminum or non-corrosive Fiberglas* construction.

Low silhouette high efficiency power roof ventilators for vertical or horizontal air discharge provide motor mounting below the venturi to achieve styling compatible with modern architecture plus a smooth airstream discharge pattern.

Above: High capacity power unit specifically designed for industrial usage. Fumes, smoke, dust-laden and foul air projected high above roof to prevent re-entry into building. "Blow-open" dampers rest on neoprene seal. Completely weatherproof.

Other type ventilators include: Rotary, Stationary, Directional, Continuous Ridge, Unit, Power models.

WESTERN ENGINEERING & MFG. CO.

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*TM- Owens Corning Fiberglas Corp.

Write for catalog and name of nearest representative

Since 1921

New Appointments

Earl E. Trickler, vice president of marketing for the New York Blower Co., has been elected president of the Air Moving & Conditioning Association. Trickler said AMCA is now revising its standard methods of testing and standards for air moving equipment.

E. E. Trickler

William E. Hoctor has joined Westinghouse Electric Corp.'s Air Conditioning Div. as manager of manufacturing. He succeeds **Burr Tupper** who has become director of works engineering at Westinghouse headquarters in Pittsburgh. Hoctor was formerly general foreman at Westinghouse' motor and control division.

W. E. Hoctor

Albert H. Clem has been named to the new post of vice president of marketing for Pennsalt Chemicals Corp. The move signals greater emphasis on marketing activities by Pennsalt.

George R. Lawson replaces Clem as general manager of the chemical specialties division. Lawson was formerly director of marketing for the industrial chemicals division.

Robert Zahn was recently appointed vice president and general manager of Air Filter Corp., Milwaukee. He will do special work in the development of new products.

Alex J. Wason, River Edge, N. J. is now representing the International Oil Burner Co. in northern New Jersey and metropolitan New York City.

Ernest R. Gedeon has been appointed superintendent of the Niagara Falls, N. Y. air pollution control division effective Jan. 1. Gedeon, who was with Durez Plastics Div., Hooker Chemical Corp., succeeds Arnold Arch, now executive secretary of the Air Pollution Control Association with headquarters in Pittsburgh.

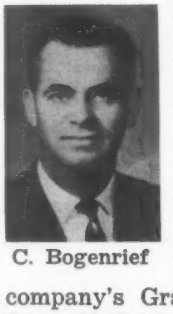
Three promotions in the field of sales organization of the Unitary Equipment Div. of Carrier Corp. are announced by William A. Lake, division general sales manager.

Roy Lansing, formerly Chicago district manager, has been named business manager of the division's western region. In his new capacity he will supervise all activities of the Los Angeles business office.

Richard K. Chapman, formerly district representative in Detroit, has become Chicago district manager.

Herbert E. Miller, formerly district representative in Washington, D. C., has been named Philadelphia district manager.

Charles A. Bogenrief has been elected vice president, manufacturing, of Robertshaw-Fulton Controls Co. Bogenrief has been director of facilities and tooling.


C. Bogenrief

Bogenrief joined the controls firm in 1937. He was head of the industrial and plant engineering department at the company's Grayson Controls Div. from 1942 to 1958, when he was appointed facilities and tooling director.

Mitchell S. Soro has joined the Chicago office of The Day Sales Co., Minneapolis, as assistant district manager.

M. S. Soro

Soro will report to D. James Dowd, district manager in charge of the Chicago office, which handles sales in northern Indiana, northern Illinois, eastern Iowa, and southern Wisconsin.

W. F. "Fred" Henke now heads the new packaged air conditioning products section of Drayer-Hanson, a division of National-U.S. Radiator Corp. Henke was formerly in air conditioning sales in Tucson, Ariz.

Drayer-Hanson also announced the appointment of **Charles A. Hasenstab** as purchasing agent, replacing **Ernest Petro,** who resigned to enter his own business.

Clyde H. Wilkinson has been appointed president of the Air Conditioning Div. of American-Standard. Wilkinson first joined American-Standard in July, 1955, as manager of water heater products for the Plumbing and Heating Div. For the past year, he has served as acting president of the Air Conditioning Div.

C. Wilkinson

Don L. Hinmon has been elected vice president for industrial divisions of Johns-Manville Corp. In his new position, he will administer operations of the Fiber Glass Div. through the general manager of that division as well as continue to serve as general manager of the Industrial Insulations Div.

Appointment of **Richard M. Norton** to the newly created position of national sales manager of Raypak Co., Inc., is announced by Alfred Whittell, Jr., president.

Norton will supervise all company sales activities outside the Southern California area, including the manufacturer's representative program.

George E. Best has joined the staff of the Manufacturing Chemists' Association as staff secretary to MCA's committees on air and water pollution abatement and chemical packaging.

Best has had previous experience in MCA activities as a member of its Air Pollution Abatement Committee from 1949 to 1955. He was active in the preparation of MCA's publication "A Rational Approach to Air Pollution Legislation."

William E. Scollard has been named manager of branch plants for Trane Co. He will administer operations of plants in Scranton, Pa., Clarksville, Tenn., and the proposed plant in Salt Lake City. Scollard was formerly planning and engineering manager for the Ford Motor Co.'s Dearborn, Mich., assembly plant.

W. E. Scollard

New Literature

Standard for Centrifugal Liquid-Chilling Packages

New standard for centrifugal liquid-chilling packages has been published by the Air-Conditioning and Refrigeration Institute.

The new standard, numbered 550-59, defines a centrifugal liquid-chilling package as a "factory- designed and prefabricated assembly (not necessarily shipped as one package) of one or more centrifugal compressors, condensers, and liquid coolers, with interconnections and accessories."

The standard does not apply to liquid-chilling packages employing reciprocating compressors, but does apply to both open and hermetic centrifugal compressors.

Standard designates what shall constitute "standard equipment" on centrifugal liquid-chilling packages, and provides that, to be in compliance, they shall be "designed, constructed, and equipped with safety devices so as to be in accordance with the latest edition of the American Standard Safety Code for Mechanical Refrigeration (ASA Code B9.1), as well as with applicable provisions of ARI Standards for "Freon" Water-Cooled Condensers, and "Freon" Water and Brine Coolers.

Copies are 40 cents each.

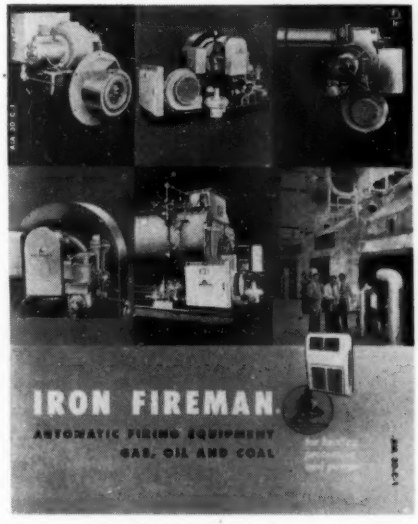
Source: *Air-Conditioning and Refrigeration Institute, Dept. AE, 1346 Connecticut Ave. N.W., Washington 6, D. C.*

Industrial Controls Catalog

General Controls Co.'s new industrial controls catalog covers automatic, temperature, pressure, level, and flow controls.

Other items illustrated and described are industrial actuators, combustion instrument controls, controller indicators, and pressure indicators.

Source: *General Controls Co., Dept. AE, 801 Allen Ave., Glendale 1, Calif.*



Industrial Heating Catalog

New 12-page, illustrated catalog shows the complete line of Iron Fireman commercial and industrial fuel burning and auxiliary equipment. "Index and Selection Chart" simplifies selection of appropriate equipment for any application.

Catalog Form 6260 covers entire Iron Fireman commercial-industrial line of oil burners, gas burners, dual-fuel burners for gas and oil, forced draft package units, boiler-burner units, coal stokers, factory wired combustion control panels, and SelecTemp heating system.

Source: *Iron Fireman Mfg. Co., Dept. AE, 3170 West 106th St., Cleveland 11, Ohio.*

Air Circulating Units

High-level circulating units for redistributing warm air from ceilings to floor areas are described in a new 4-page illustrated bulletin.

Bulletin HLC-59 covers features and engineering data on units intended to put waste heat to work by recirculating warm air from high levels to floor level.

It covers eight sizes, each available with either of two types of revolving discharge. Tables include dimensions, capacities, and area coverage, for each size and discharge type.

Source: *L. J. Wing Mfg. Co., Dept. AE, Linden, N. J.*

Report on Non-Selective Collector

Report on an 18-months research project for the design and evaluation of a portable adsorption sampler is made by Stanton B. Smith and Richard J. Grant of Pittsburgh Coke and Chemical Co.

Technical Report A59-3, "A Non-Selective Collector for Sampling Gaseous Air Pollutants," was prepared for Robert A. Taft Sanitary Engineering Center, Cincinnati.

Prototype collector consisted of two activated carbon columns in series, the second refrigerated in dry ice. Tests indicated complete collection of methane and less volatile substances at concentrations of about 150 ppm.

Source: *Robert A. Taft Sanitary Engineering Center, Dept. AE, Cincinnati, Ohio.*

Booklet on Immunol 438

New 36-page booklet describes wet magnetic particle inspection using Immunol 438 in water as the vehicle for oil soluble and water soluble inspection pastes.

Booklet cites Air Force Specifications amended to approve the water suspendable method of magnetic particle inspection, provided a suitable rust inhibitor and wetting agent are used, approving Immunol 438 specifically for the water phase vehicle.

Source: *Harry Miller Corp., 4th & Bristol Sts., Philadelphia 40.*

Fixed Pattern Diffuser Bulletin

Bulletin K-44 describes and illustrates new Kno-Draft KF fixed pattern diffuser. It gives construction and performance features with mounting directions.

Source: *Connor Engineering Corp., Dept. AE, Danbury, Conn.*

Use Communications Center, page 35, for requesting more information about articles, advertised products, literature, etc.

Study of two buildings gives data on . . .

Gas vs. Electricity As A Fuel

PART I

Fig. 1: *First Methodist Church, Belleville, Mich., was one of two buildings studied by consulting engineer when comparing gas vs electricity for heating system.*

Here are factors which influence choice of electrical or gas-fired heating systems. This first of a series takes up study of two new buildings by a consulting engineer comparing gas vs electricity

WHICH FUEL TO USE, gas or electricity, depends on many factors, among which are cost of the fuel; architectural treatment of the building, cost of insulation, labor and mechanical equipment.

In this first of a series, we present a case history study of an engineering analysis of two buildings, a school and a church, in which gas gets the nod. Later, we plan to present data supporting use of electricity in buildings for which this type of heat is best suited.

The two case histories presented below were prepared by G. Gatchell, of Gatchell & Burwell, Inc., Detroit, consulting engineers. The church is the First Methodist Church, Figures 1 and 2 in Belleville, Mich. The school is the new elementary school of Kearsley Community Schools, Genesee County, Mich., Figures 3 and 4.

The church building was built in 1958, of block and brick construction. The two-story building has a 350 seating capacity nave, with a large fellowship hall, class rooms, kitchen, and sanitary facilities.

Building originally planned was 20,000 sq. ft., with 15,000 sq. ft. to be built in the first unit.

During early stages of planning, the church building committee informed the architects and engineers that they were interested in electric heat for their building.

The engineers studied the possibility of a conventional gas fired hot water heating system, as well as a resistance type electric heating system. Their findings are given below:

Initial Cost, Church Heating System

Both the gas-fired hot water and the electric resistance heating systems were laid out and contractor's prices obtained on the 20,000 sq. ft. building.

Bids for the gas-fired system with conventional building insulation:		$27,500
Bids for electric heating system:		
Electric heating system	$20,000	
Additional required insulation (see data on insulation below)	20,000	$40,000

Required Building Insulation

Gas

Due to the low cost of gas as a fuel, conventional building construction may be used; i.e. – 4 in. brick and 8 in. block on outside walls, single glass windows, about 1 in. roof insulation.

Electric

Detroit Edison requests that if electric heat is desired, the building be provided with 2 in. insulation in floors, 4 in. insulation in walls and 6 in. insulation in roof; also double glass or thermopane windows.

Comparative Heat Loss

CONVENTIONAL BUILDING
vs
HEAVILY INSULATED BUILDING

U factors (Btu per hour per °F. temperature difference between inside and outside temperature per sq. ft. of area) would vary as follows:

	Regular	Edison Insulated
Walls	.33	.06
Windows	1.13	.55
Roof	.11	.04

Floor losses have not been compared as they comprise less than 5 percent of heat loss.

The overall building heat loss would be about 40 percent of conventional heat loss, if the building is insulated per Detroit Edison requests.

Advantages – A well insulated building is very comfortable, because of high surface temperatures on outside walls and windows, which reduces body radiation to outside walls. Also building will remain cooler in summer weather.

Disadvantages – Double glass or thermopane windows are usually fixed sash, which would require mechanical ventilation throughout building. This could be accomplished with unit ventilators or central fan systems, either of which would be expensive.

Operating Cost

Gas – Conventional Building

Using a degree-day basis, according to American Society of Heating & Air Conditioning Guide, 1957 issue, page 462 (4) and page 468, table 4, for a building with heat loss of approximately 1,000,000 Btu per hour, fuel consumption would be:

Fig. 2: ***Nave of First Methodist Church, Belleville, Mich., heated by hot water, gas-fired system.***

F (Fuel Consumption) = U (Unit fuel consumption) × N (Heat loss) × D (Degree days).

$$F = \frac{.068}{\text{165 Btu/hr per sq. ft. E.D.R.}} \times 1{,}000{,}000 \times 6500$$

F = 2,700,000 cu. ft. of gas per year

At current Michigan Consolidated Gas Company rate, cost per year = 2,700,000 × .0078 = $2,100.00.

Gas (Insulated Building)

Cost per year = 40 percent of conventional building
= .40 × $2,100.00 = $840.00

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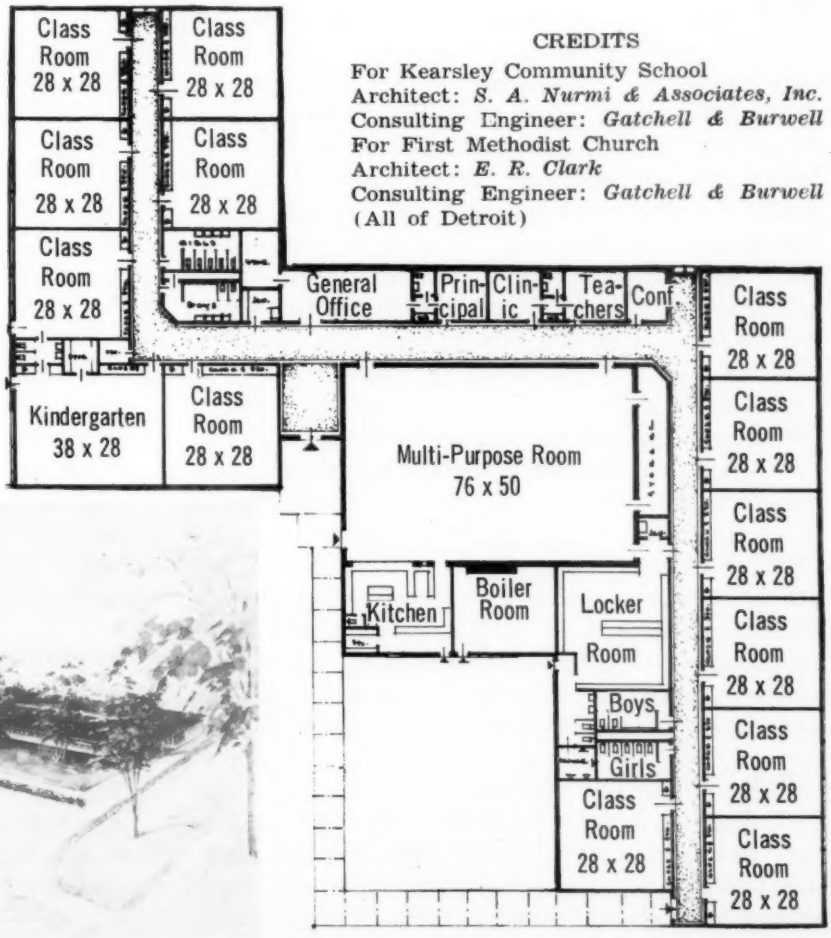

Fig. 3: ***Right, floor plan of Kearsley Community School, near Flint, Michigan. This school was also subject of a comparative study of gas vs. electricity for heating.***

Fig. 4: ***Below, rendering of Kearsley Community school, heated by gas-fired hot water heating system.***

CREDITS

For Kearsley Community School
Architect: *S. A. Nurmi & Associates, Inc.*
Consulting Engineer: *Gatchell & Burwell*
For First Methodist Church
Architect: *E. R. Clark*
Consulting Engineer: *Gatchell & Burwell*
(All of Detroit)

(Continued from preceding page)

Gas-Electric Comparison – Conventional Building

@ the rate of 2¢ per kwhr = 2¢ per 3400 Btu

$$\textit{Electric cost} = 2¢ \times \frac{100{,}000}{3400} = \underline{59¢ \text{ per } 100{,}000}$$

Gas cost = 78¢/1000 cu. ft. = 78¢ per 1,000,000 Btu input

$$\text{@ 75 percent eff.} = \frac{78¢}{(1{,}000{,}000 \times .75)} = 78¢$$

per 750,000 Btu output =

$$78¢ \times \frac{100{,}000}{750{,}000} = \underline{10.4¢ \text{ per } 100{,}000 \text{ Btu.}}$$

Electric – (Conventional Building)

At approximately 5 times the cost per unit of heat, electrical cost per year = 5 × $2,100.00 = $10,500.00.

Electric – (Insulated Building)

Cost to heat per year would be 40 percent of conventional building = .40 × $10,500.00 = $4,200.00.

Advantages – Electric Heat

1. Maintenance would be less.
2. No boiler room with accompanying dust and dirt.
3. Very quiet operation.
4. Very little replacement of parts.
5. Each room can be individually controlled very easily.

Disadvantages – Electric Heat

1. Gas service would probably still be required for incinerator and possibly kitchen equipment. Gas and water meters, water heaters and incinerator would require a separate room, and a chimney.

Advantages – Gas Heat

1. Low operating cost.
2. Heat can be easily modulated providing some heat at almost all times under windows, reducing cold draft.
3. Additional heating capacity can easily be attained by increasing water temperature.
4. Boiler room will probably not require any more area than required by transformer room.

Conclusions

The engineers recommended that gas be used to heat the building, because of lower first cost, lower operating cost and more uniform heat. The church building committee unanimously voted for the gas system, which was installed.

School Building History

The school building is located near Flint, Michigan, and is now under construction. During early stages of planning, the school board expressed a keen interest in an electric heating system. The consulting engineers, together with members of the school board, visited an electrically heated school in Utica, Michigan.

The engineers then studied the possibility of an electric heating system, as well as a conventional gas-fired hot water heating system. Their findings are given below:

Comparative School Heating System Costs

GAS-FIRED hot water heating system cost was estimated at:	$40,000
Actual heating contract for hot water, gas-fired heating system was substantially below engineer's estimate, at:	$35,000
ELECTRIC HEATING system cost was based on secondary service (to eliminate the cost of transformer and the cost of vault). From previous electric heating systems designed by this engineer, and from other existing electrically heated schools visited, (Utica, Mich.) cost of the electrical heating system was found to average about $1.00/sq.ft. (installed cost, including equipment and labor). This school is 25,000 sq.ft., therefore the electrical heating system cost would be $1.00 x 25,000 or:	$10,000 / $25,000
To this cost was added:	
4 in. more ceiling insulation @ $.20/sq.ft. x 25,000	= $ 5,000
4 in. wall insulation @ $.60/sq.ft. x 5,000	= 3,000
Floor insulation, 2 in.	1,000
Thermopane glass in place of single glazed glass	5,000
	$14,000
Total Electric System Cost:	
Electrical system installed cost:	$25,000
Additional insulation and thermopane:	14,000
	$39,000

School System Data

Referring to the church building electric heating report given prior to this school system data, it can be seen that electric heat systems must have an extremely well insulated structure.

From the church report, it can also be seen that the electric heat system, with heavy insulation, will have a heat loss of 40 percent of a conventionally insulated building of the same type.

Operating Costs

Referring to the church building electric heating system data above, it has been shown that electric heat costs are five times that of gas, for uninsulated buildings (such as the concrete block and brick school described here, near Flint) and two times that of gas for heavily insulated buildings.

The Consumers Power Co. gas rate is

(Please turn to page 58)

When you lay out air conditioning and heating equipment, here are . . .

15 Ways to Lower Maintenance and Operating Costs

Fig. 1: *Valves are located for ease of access and operation in this photo, which shows pumps to handle 40 percent by volume ethylene glycol for snow melting system. Note good lighting arrangement above this pump location.* Photo, courtesy Michigan Department of Health.

by W. J. Benesch
Chief Engineer, Syska & Hennessey, Inc. Engineers

Whether you design heating and cooling systems . . . or will be responsible for system maintenance and operation, here's an article by a top engineer on ways to layout mechanical equipment that can result in substantial savings in maintenance and operating costs.

ALL TOO OFTEN, WHEN A NEWLY-COMPLETED BUILDING is turned over to its operating personnel, the lack of adequate space for mechanical equipment becomes apparent. And the net result is high operating and maintenance costs.

By this time it's too late, however. Necessary changes are costly and time-consuming. They also are troublesome and disruptive to tenants and owners alike. Yet for the owner to struggle along with crowded and cramped mechanical installations is equally costly, especially with today's rising salaries and high operating costs.

Maintenance and operating problems should be foreseen and planned for by the designing architects and engineers. To keep down the cost of these services, their criteria should include:

1. Allocation of sufficient mechanical space
2. Accessibility of machinery and controls
3. Considered selection of materials
4. Automatic operation
5. Detailed inspection during construction

It's understandable for the owner of a proposed new building to want as much rentable space as possible. But he should consider seriously the importance of providing sufficient space for the operation and maintenance of mechanical equipment that gives "life" to his building. Good planning and adequate space allocation in early design stages will save hundreds of man-hours in subsequent operating and maintenance costs – and will offset any loss of rentable income that the extra space precludes.

What are some of the more obvious examples of this unwise squeezing?

1. Narrow service corridors hamper the handling of materials for building alternations and maintenance.
2. Small elevators and freight cars slow down movement of maintenance personnel, their tools and materials; also mail, freight, and other factors needed for the structure's normal operation.
3. Inadequately-sized porters' closets cannot accommodate enough supplies for a single floor, so the porters make numerous additional trips to remote storerooms.

And so it goes. The increased waiting time and the multiple trips soon add up to thousands of dollars for management. Either the standard of maintenance is lowered or extra personnel are needed. In either case, it results in a costlier operation.

The penalties paid in time, money and inadequate servicing because of space limitations have been bad in the past. But with the increase in the amount of complex mechanical equipment in today's buildings, the situation is bound to worsen unless plans are made in advance to avoid it.

A relatively simple maintenance or repair job can

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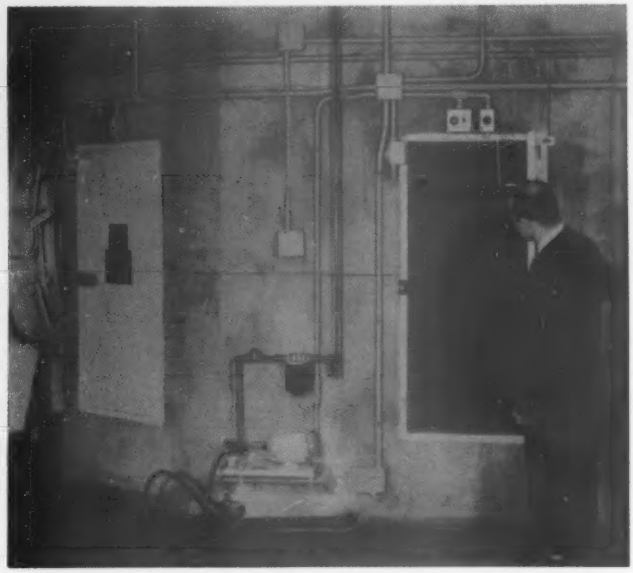


Fig. 2: *Shown here are two access doors. Door on right leads to electrostatic precipitator, is used during cleaning, inspection, maintenance. Door at left is to inlet of fan scroll. Note clean approach to both doors, uncluttered by piping, ductwork, wiring, machinery, permitting ease of access. At bottom of photo, on floor, between access doors, is a convenient floor drain.*

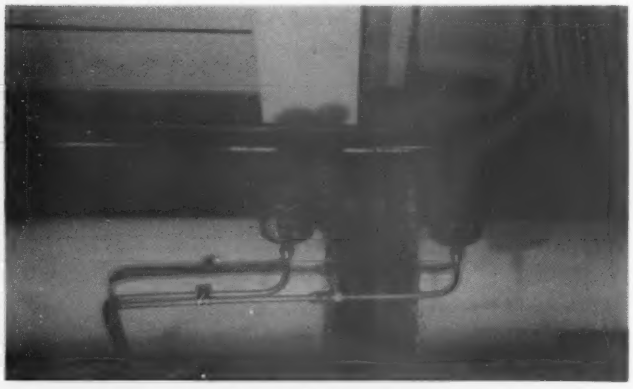
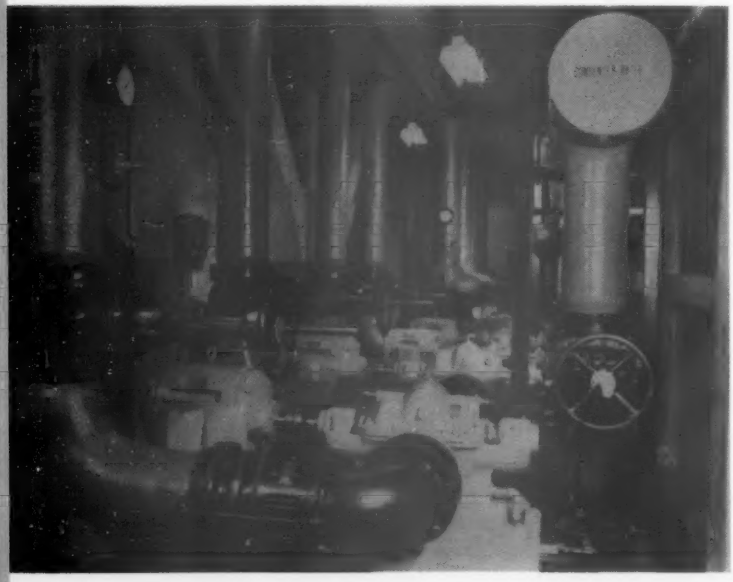


Fig. 3: *Main steam line orifice taps and flange are shown in this photo.*



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be made complicated by lack of space. An inaccessible piece of equipment that needs repair or replacement can sometimes be reached only by dismantling some other equipment in front of it, again causing disruption of services and tenant discomfort.

A case in point: Because of limited space conditions, several dehumidifiers were located side by side. They were placed so close to one another that the cooling coils could not be removed from one without first dismantling the other units. Consider the waste of time and money in dismantling three units every time cooling coils had to be repaired on one. Silly, but the result of space squeezing.

In other instances one piece of equipment must be placed above another because of lack of space. Maintenance personnel, in order to reach the high, inaccessible unit, will use the lower one as a temporary platform and damage it.

At other times a disinterested maintenance man may neglect out-of-the-way equipment instead of struggling to reach it. Costly breakdowns and equipment failures result. Typical of this situation is the awkward location of thermometers and automatic temperature-control equipment which, by their nature, must be located near the equipment they control.

Accessibility Important

Even if adequate physical space is allotted for machinery and equipment, the general area must be accessible. If equipment is located in a security area, for instance, maintenance men must wait for doors to be unlocked. They are then supervised in their work and costs again begin to mount.

Costs for contract maintenance work on filters, water treatment, etc., are based on free access to equipment. When time is lost in servicing, the rate naturally increases.

In one instance the mechanical room serving 12 stories of a building could be entered only through a tenant's reception room, which was luxuriously furnished and had expensive solid-color, wall-to-wall carpeting. It was necessary for maintenance personnel to change their shoes every time they entered or left the equipment room. Such a condition may or may not be the result of faulty design. If not, then the management should have been acquainted with the situation and renting arrangements so set up that direct entrance might be had to the equipment room.

Valves should be placed in strategic locations and in such a manner that repairs can be made to a small area of the building without necessitating the shutdown of the entire building.

Air diffusers which require maintenance should

Fig. 4: *These condenser water pumps are interconnected so they can be operated individually or in any combination. Check valves are provided for individual pump operation as required.*

be so designed and located that they can be cleaned and serviced with minimum effort. Some units installed in buildings today require a major project for such a simple job.

Often heavy equipment must be moved for maintenance or replacement and improper space planning has resulted in injury to personnel and nearby equipment. Sufficient space should be allocated above heavy water boxes, condenser heads, transformers, switchgear, motors, elevator machinery and other heavy equipment, and proper hooks and hoisting devices provided for safe removal of units and components.

Maintenance And The Construction Budget

One of the factors contributing to high maintenance costs is the tendency to sometimes sacrifice quality in order to reflect an initial low figure and thus stay within a budget, which itself is often set too low at the outset. This can only ultimately result in continued high maintenance and replacement costs, since false economies and calculated risks are undertaken.

One example of false economy is the decision, for instance, to use close-coupled type pumps where, for good maintenance and operation, horizontal split-case type would be dictated. In almost every instance this is penny-wise and dollar-foolish.

One of the calculated risks that engineers, owners, and architects are tempted to try is the reduction of the number of zones for perimeter type air conditioning. Occasionally, where original designs call for independent zoning on each exposure, one system is used instead, under the guise of economy and space saving.

The result is almost always dissatisfied occupancy, followed by the almost impossible task for management to rectify and correct the condition. Final result is modification of the system by various means and, whatever the solution, it's bound to be costly – and in most cases is not altogether satisfactory.

In the more complex modern buildings of today, lowering of operating costs and conservation of manpower can be obtained through automatic operation of mechanical and electrical equipment. Clocks, electric eyes, "supervisory systems" and other automatic devices can operate and control equipment dependably and accurately.

Many arguments have been presented for and against this type of "automation," but current active installations, with automatic controls and proper operating procedures, are functioning satisfactorily and efficiently – proving that it can be done.

In a large installation, where mechanical rooms are scattered throughout the entire project, schedules

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Suggestions For Lower Maintenance And Operating Costs

1. Locate frequently-operated valves for ease of access and operation.
2. Locate floor drains in such a way that piping need not be run over the floor, creating unsightliness and tripping hazard.
3. Provide for orifices in main steam lines, condenser mains, and chilled water mains at time of installation; later orifice plates can be installed after proper capacities have been determined through actual operation.
4. Don't stint on the number and size of access doors. Size them generously for adequate future maintenance and cleaning of filters, coils, and bearings. Call for access doors in fan scroll casings to insure proper cleaning of fan interiors; also in duct work to permit periodic cleaning of interiors.
5. Interconnect as much equipment as possible where economically practical, to provide maximum flexibility for possible contingencies.
6. Provide sufficient space in fan rooms for proper duct design, thus eliminating need for inefficient abrupt bends at fan discharge and intakes.
7. Specify waterproofing of floors for all areas where water is used, such as spray pans and pumps; particularly where equipment floors are above tenant-occupied spaces.
8. Provide ample lighting near machinery, and particularly in corners of fan rooms.
9. Allow ample space near and above heavy exchangers, pumps, etc., to permit installation of proper rigging for removal.
10. Locate steam stations and steam meter rooms away from air conditioned areas. When conditions will not permit such design, provide suitable insulation and special supply ventilation to carry off heat before it affects adjacent areas.
11. Consider comfort of operators in boiler rooms, compressor rooms, and other areas where heat-producing equipment is located.
12. Locate apparatus and machine rooms a sufficient distance from occupied areas to prevent vibration and noise from penetrating to them. When this is impossible, include necessary corrective sound and vibration isolation.
13. Control all piping layouts during installation to guarantee no future interference with access door openings or equipment that must be serviced.
14. Provide ample protection in heavy traffic areas for insulation on piping, ductwork, and fan enclosures, often damaged by periodic maintenance.
15. Make sure that there are sufficient flanges and unions in piping of heavy apparatus, pumps, and other new equipment so that as little piping as possible will be disturbed and a minimum of dismantling encountered for small repair jobs. This precaution is best controlled during construction.

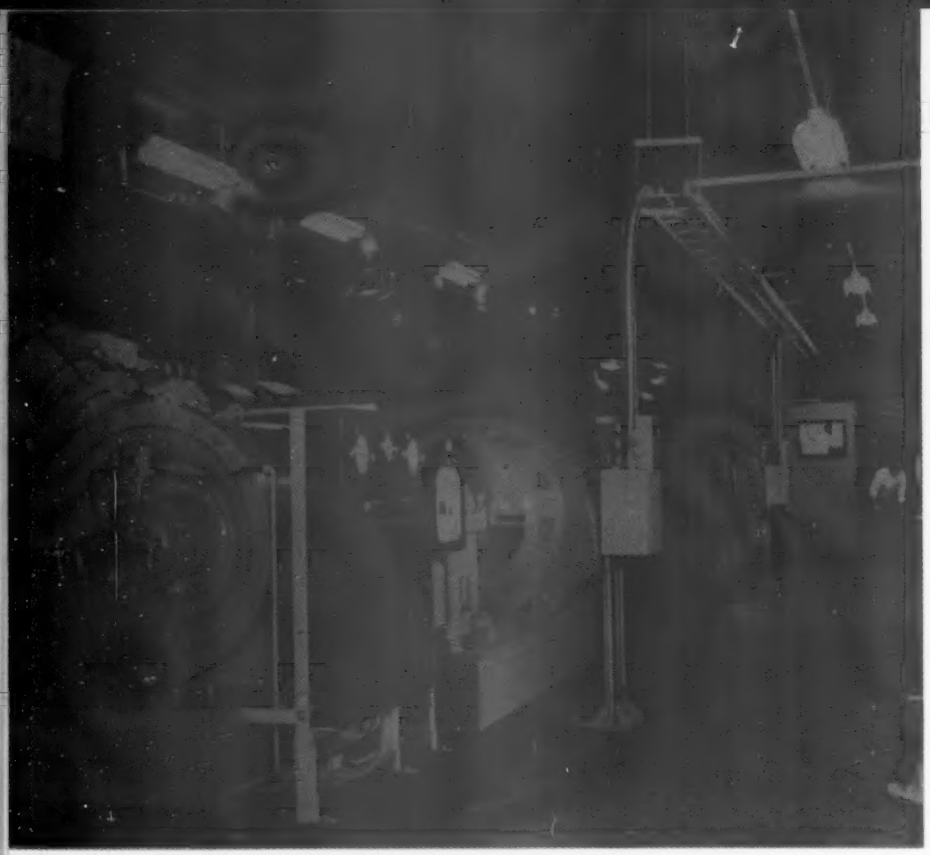

Fig. 5: *Compressors are spring mounted for minimum sound transmission to tenant floor below. Note good lighting arrangement, room for rigging in case machinery has to be removed for repair. Floor in this photo, and in all other photos shown in this article, are waterproofed to prevent water seepage to tenant floor below.*

(Continued from preceding page)

can be set up so that clock controls will actuate fans, lights, pumps, motors, and similar equipment, making it unnecessary for maintenance personnel to do the job manually.

Those in disagreement with automatic controls will be quick to remark that it's good practice for the maintenance man to check fan belts, bearings, and other components at the same time the unit is activated. It's been found, however, that with a proper preventive maintenance program, the system can be operated automatically and periodic routine inspection accomplished during the operating hours.

Another objection to automatic operation is based on safety hazards. A maintenance man, unfamiliar with automatically controlled equipment, might actuate it manually and disrupt the time cycle. Or, they fear, an automatic clock might turn on a piece of equipment remotely while it's being serviced.

These possibilities can easily be overcome by properly marking equipment on automatic control and instructing maintenance personnel in precautionary measures to avoid accidents when working on such equipment. Protective lock-out devices are a simple means of preventing automatic activation of equipment during servicing.

A well-thought-out and well-designed mechanical system is only as good as the contractor's fabrication and installation. Many operating problems are traceable to faulty installation and are not discovered until long after the contractor has left the job. Thus, inspection by the consulting engineering firm that has evolved the design is of prime importance during the construction phase.

Corrective work and replacement costs are time-consuming and expensive. Clogged strainers, loose or jammed dampers, obstructions in ducts, unbalanced air distribution are just a few of the possible conditions that might well have been eliminated by a thorough program of inspection and supervision during the construction period. ▲▲

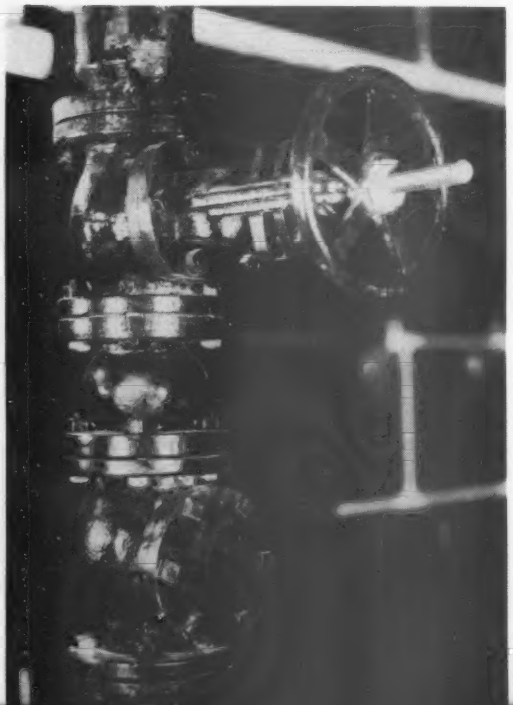

Fig. 6: *Here's a good example of proper flanges, etc., in piping to permit minimum of dismantling when repairs are necessary. This photo shows a pump discharge line, with check valve and stop valve.*

For detecting, measuring, sampling . . .

Instruments For Air Pollution

by R. L. Swift
Technical Products Division
Mine Safety Appliances Company

Here's a round-up of modern instruments used in air pollution control, for fast detection and measurement of contaminants of most common types from industrial processes.

Fig. 1: *A sample of airborne lead particles is being taken with electrostatic precipitator sampler, at torch soldering operation.*

SINCE THE BEGINNING OF THE HUMAN RACE, man has been bothered by contaminants in the air. For hundreds of years, however, dusts, smokes, gases and vapors were accepted as necessary evils or even more popularly, as a measure of economic prosperity. In the last two decades, concurrent with tremendous industrial growth, the realization has come that something must be done about these contaminants in the air, now classified as air pollutants.

We not only have smoke and dust, but the by-products of our ever expanding industrial output are in many cases harmful to life, agriculture, and property. Industries and communities, industrial hygienists and safety engineers alike are deeply concerned about the quality of the air we breathe.

To help analyze suspect atmospheres, a number of specific measuring and collecting instruments have been developed. These can be divided into two broad classifications:

1. Those which serve as collection devices; and
2. Those which give an immediate indication of the amount of the specific contaminant for which they were designed.

Sample Collection Instruments

In general, the instruments in this category are used to collect samples of airborne dusts and aerosols, which are then submitted to laboratory analysis in order to determine the exact constituents.

The electrostatic precipitator is a modern highly efficient precision instrument for the quantitative sampling of airborne particulates. It was designed for use not only in air pollution work but also for industrial processes, ventilation engineer and many other applications.

The electrostatic sampler (Fig. 1) consists of a portable sampling head, high voltage power supply and cable, telescoping support for the portable head, removable sampling tube kit, and three-wire grounded power supply cord – all contained in a carrying case. The portable head provides flexibility and freedom of movement for sampling.

It weighs only four pounds and is self-contained with a blower which provides a constant flow of 3 cu. ft. of air per minute through the instrument. Power pack provides an adjustable high voltage to the electrode. Emission of electrons by this ionizing electrode provides a charge for incoming particulates in the atmosphere being sampled, which are then deposited on the collecting electrode.

Determinations can be made by weight without removing sample from the tube, or sample may be extracted for other methods of quantitative or qualitative analysis. Up to 200 milligrams of sample may be collected.

The fixed flow air sampler (Fig. 2) is designed to collect large samples of aerosol contaminants on filters for weighing and analysis. An automatic flow control has been incorporated so that a constant volume of air is drawn through the filter over entire collection period. A motor driven damper valve is regulated by resistance to air flow through the paper. This permits use of a wide range of filter media.

The cascade impactor (Fig. 3) is a device de-

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signed for quantitative and qualitative sampling of atmospheric aerosols in size range of 200 microns – ½ micron. It consists of a system of four air jets impinging in succession on glass discs. The jets are progressively finer, so that speed and efficiency of impaction of particles increases from jet to jet when air is sampled at a constant rate. The jets have been designed to give line deposits, one of the most suitable forms for microscopic analysis.

As a companion instrument whose efficiency is practically 100 percent for particle sizes up to 5 microns, the thermal precipitator has earned a good reputation for accurate, reliable dust sampling. Device functions by making use of the phenomenon of dust-free space which surrounds a hot body.

In this instance, an electrically heated resistance wire produces the dust-free space. Into this space, two microscope cover glasses are inserted. Air containing dust to be measured is drawn through the unit. Dust particles, unable to penetrate the dust-free space, are deposited on the glasses, which can be removed and the particles sized by standard microscopic methods.

Dust Sampling

A portable, hand-operated instrument for dust sampling in any location, the midget impinger (Fig. 4) takes dust samples from atmosphere without use of compressed air or electricity. It is used for dust-surveys and control work by state industrial hygiene bureaus, U. S. Public Health Service, U. S. Bureau of Mines, and industrial plants.

The midget impinger apparatus weighs less than ten pounds. Operated by a hand-cranked 4-cylinder pump, this portable unit samples at the rate of 1/10 cfm. Pump, in conjunction with a vacuum regulator, maintains a steady flow, despite minor variations in rate or smoothness of cranking.

As the name implies, this instrument employs impingement methods of drawing air at a relatively high velocity through a small glass nozzle. The nozzle directs air sample so that it strikes bottom of a glass flask, which is partially filled with a liquid such as water or alcohol, or a mixture of these liquids.

Dust particles contained in the air are wetted and retained in the liquid while the air bubbles through and is exhausted. A portion of the liquid is examined microscopically, and a count of the dust particles is made.

For sampling conditions where use of rubber in the collection system might be objectionable, all-glass impingers are available. These all-glass flasks may be used with either a nozzle for dust sampling or a fritted glass bubbler for sampling a wide variety of gases and vapors.

For general industrial testing, direct measuring instruments can be divided into three broad cate-

Fig. 2: *For collecting large samples of aerosol contaminants, this fixed flow air sampler gathers contaminant samples.*

Fig. 3 *For quantitative and qualitative sampling of atmospheric aerosols from 200 microns down to one-half micron, this cascade impactor is a useful instrument.*

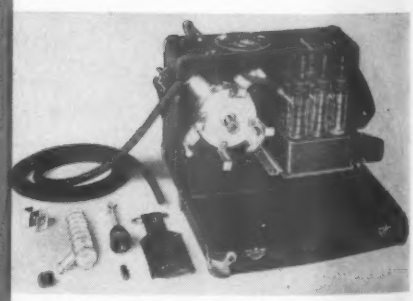

Fig. 4: *Midget impactor can be used without connections to compressed air or electricity.*

Fig. 5: *For toxic gases this tube type detector was first developed by the National Bureau of Standards.*

gories: A. Glass Tube type detectors; B. Filter Reagent Samplers; C. Hot-Wire Catalytic Combustible Gas Indicators.

Tube type detectors are those in which the gas of interest reacts with a chemically impregnated gel to give either a length of stain or color change proportional to the concentration.

Most widely used of this group is the carbon monoxide tester (Fig. 5). Detector tubes used in this instrument were originally developed by the National Bureau of Standards. These tubes, which are the heart of tester, contain impregnated silica gel. After sealed ends are broken off and tube inserted into the frame, a controlled sample flow is aspirated through the chemical.

Any carbon monoxide present will react with the impregnated gel to give a shade of green whose color intensity is proportional to concentration. A revolving color chart and scale is mounted directly beside the detector tube.

Sensitivity of this tester is such that carbon monoxide concentrations from 0.001 to 0.10 percent by volume can be measured. This wide range of sensitivity is obtained by varying number of squeezes of the aspirator bulb used to draw air sample through detector tube. Chart correlates concentration to color and squeezes.

Practically all other tube-type detectors for other gases also rely on a chemical reaction between the contaminant of interest and an impregnated silica gel to give a colored stain, length of which can be related to concentration. Range of sensitivity is broadened by increasing volume of sample drawn through the detector. In most instances, the utmost in sensitivity is obtained by very carefully adjusting rate of flow through the instrument. Consequently, individual instruments should be used when accurate analysis is required.

Stain Type Detectors

Some of the compounds for which length of stain type detectors have been made are hydrogen sulphide (Fig. 6), chlorine, mercury vapor, halogenated hydrocarbons, and nitrogen dioxide (Fig. 7).

In order to obtain the greatest degree of stability, and consequently, accuracy, chemicals used for detection of certain compounds are furnished in separate, sealed tubes. Prior to a series of tests, these chemicals are mixed and then placed in detector tubes.

Rubber caps are provided for the tubes, so that chemicals retain their sensitivity for up to three weeks. Sufficient materials are included in separately packaged kits to perform 12 individual tests. Detectors are available for measuring concentrations of hydrocyanic acid gas, sulphur dioxide gas, and aromatic hydrocarbons such as benzene, toluene, and xylene in the M.A.C. ranges (Fig. 8).

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Fig. 6: Stain type detectors like this are used for detection of vapors such as hydrogen sulphide.

Fig. 7: This stain type detector is for nitrogen dioxide. Chemicals are mixed before tests, show presence of vapor by color of stain.

Fig. 8: Stain type detector shown here has rubber cap, like all such detectors, to retain sensitivity for vapor it is designed to detect.

(Continued from preceding page)

With filter reagent detectors, measurements are made by drawing a fixed volume of sample either through or across a filter which has been impregnated with a freshly prepared reagent solution. Contaminant of interest reacts to form a color stain, which can then be compared with a color chart to determine the concentration present.

In general, the fact that indicating reagents are unstable in storage has long presented a problem in field testing. Ingredients which make the solutions, however, are generally very stable. By taking advantage of this latter property, need for field measuring, mixing, and transferring equipment has been eliminated. Measured amounts of each ingredient are stored in sealed frangible glass ampoules, which in turn are packaged in pliable dispensing containers.

Solutions are prepared by crushing the ampoules inside the plastic syrettes, and shaking until thoroughly mixed. Reagents are then easily dispensed dropwise into filter media being used.

Where relatively small volumes of sample will produce a good color stain, an aspirator bulb with an adapter to hold the filter provides a simple sampling device. Hydrogen fluoride (HF) and unsymmetrical dimethyl hydrazine (UDMH) are two compounds currently being used in rocket and missile fuel programs which can be detected in this way. (Fig. 9.)

Fig. 9: A simple aspirator device for detecting relatively small volumes of sample with aspirator bulb and special filter is used to detect gases.

Fig. 10: Hot wire catalytic filament detector is used to detect combustible gases in percentages of the lower explosive limits (LEL).

When it is desirable to use a larger volume of sample to obtain the desired reaction, a 500 ml hand pump is used. An adapter on the pump inlet holds the filter in place. The filter area exposed can be altered by varying the size of the opening in a snap-on cap which is a part of the adapter assembly. Compounds of lead in air, arsine, boranes-in-air, and chromic acid mist are typical of the contaminants which can be measured by this type of instrument.

Hot Wire Detectors

For many years the hot-wire catalytic filament type combustible gas indicators have only been associated with gas concentration measurements in percentages of the lower explosive limits (LEL). However, with the advent of better filament manufacturing techniques, improved components, and more sensitive meters, it is now possible to measure toxic concentrations of combustible gases.

Usually these instruments are furnished with a dual range. One range measures from 0 to 100 percent LEL while the other indicates concentrations from 0 to 10 percent LEL. Thus if LEL of a particular gas is 1 percent by volume, full scale deflection of lower range would be 0.1 percent by volume or 1000 ppm. Calibration curves and/or conversion charts are furnished to correlate meter readings with lower explosive limits of various combustible gases. Fig. 10 shows a typical instrument of this class.

In reviewing portable instruments that are now available to industrial hygienists and air pollution control engineers, it is apparent that rapid strides have been made in the last decade to develop tools necessary to measure hazards of a great many present-day air pollutants. ▲▲

To prove your plant is "Not Guilty," learn all about . . .

How Dust Particles Are Identified

by M. A. Salzenstein
Project Engineer
Walter C. McCrone Associates

Pollutant particle identification is a task for the scientific sleuth. This article tells how particles are identified . . . how such identification can often pin point the source of the pollutant.

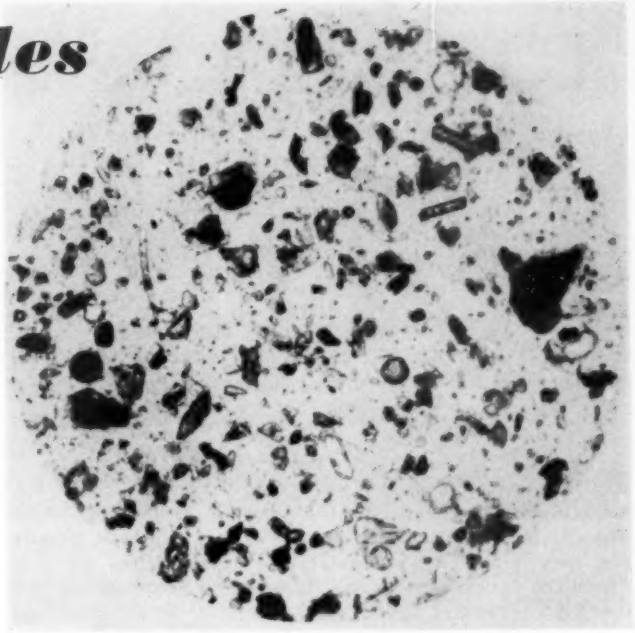

Fig. 1: *Particulate matter sampled near a heavily-traveled street. This sample is typical of the diversity of sources contributing to air pollution.*

One of the problems in air pollution control is the identification of particular air pollutants. When that pollutant is a solid particulate, use of the microscope can greatly simplify the analysis.

It is not unusual to find that a sample of particulate matter filtered from the air contains wood, quartz, limestone, clay, iron oxide, silicates, paper fibers, insect parts, seeds, soot and paint particles. Thus one is dealing with an extremely complicated mixture coming from many diverse sources (Fig. 1).

Many of these materials, and others, can be almost instantly identified by observation of their morphology under the microscope. This technique is especially valuable for multi-component systems, such as we have in an air pollution sample.

The study of morphology is the study of external form or shape. The human eye and brain are constantly using morphology of objects, animate and inanimate, in everyday life to identify friends and relatives, to choose the proper key to unlock the front door, to find a car in a parking lot, and so on. The method is not infallible, as anyone knows who has tried to unlock the door of the wrong car or been rebuffed by a person mistaken for an acquaintance. Nevertheless, with training to develop the powers of observation and a good memory, a man can recognize with certainty a large number of people, cars, airplanes, trees and animals.

In the same way, a microscopist is able to identify a surprisingly large number of metals, bacteria, plant and animal fibers, pure crystalline compounds, pollen grains, starch grains and so on. The weight of any given particle may be well below 10^{-10} gram, making microscopic identification an extremely sensitive tool of analysis.

There are two types of microscopes that serve the microscopist well in particulate matter identification. The first is the stereomicroscope, such as shown in Fig. 2. This is essentially two microscopes put together so as to observe a sample simultaneously at two different angles. Each eye of the observer receives a slightly different view of the sample. These two images are fused in the brain to form a stereoscopic image; that is, one having depth and form.

The value of this image presentation is that one immediately sees the sample magnified in bold relief. Roundness, shape, form and surface texture are strikingly brought out. Many times this reveals the identity of the particles being observed. The first step, then is to examine the sample with the stereoscopic microscope.

Fig. 3 are stereoscopic pairs of images taken on such a microscope. In order to fuse them without the aid of a viewer, the reader can try the following exercise: Relax your eyes by looking at a far wall. With your eyes still focussed on the wall, raise the figure about 10 in. from your eyes, until the stereo

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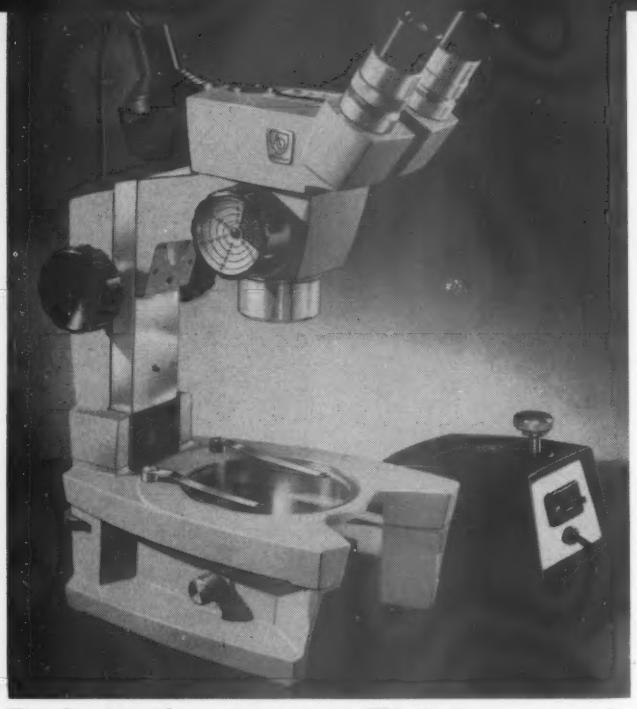

Fig. 2: *A modern stereoscope. This instrument permits the viewer to see particulate matter magnified up to 80 times, in three dimension.* Photo, American Optical Co.

(Continued from preceding page)

photograph intersects your line of sight. Now, without moving or accommodating your eyes, transfer your attention to the photograph and move the page back and forth. At one point, where you saw four separate images earlier, the two central images will converge and fuse into a three dimensional picture. If you don't succeed at first, try again. With a little practice, you will be able to fuse stereo pairs with little difficulty without a viewer.

After one has exhausted the possibilities with the stereomicroscope, the sample may be transferred to a slide to be examined under the polarizing microscope, such as the one in Fig. 4. The stereomicroscope may be helpful here when it is desired to choose only one or a few particles in a conglomeration of air pollutants and to further study these particles individually with the polarizing microscope.

The polarizing microscope is unique among microscopes in that it has a rotating stage and a means for viewing the specimen in polarized light. The rotating stage permits one to view a specimen and observe its appearance as it is rotated in polarized light. The stage is also graduated in degrees, so that crystal angles may be measured accurately. With this instrument, it is possible to check some physical constants of the particle in question. These characteristics include refractive index, birefringence, crystal angles, melting point, solubilities and reactions with specific reagents.

How Particles Identified

What the microscopist looks for in order to identify a sample on a purely morphological basis is a difficult question to answer precisely. It is stating the obvious to say that he looks for those shapes, structures or markings which will be characteristic of the material; however, this is exactly what is done. The characterization is made somewhat scientific by following a mental check list and asking the questions: is it fibrous, crystalline, colored, transparent or opaque, uniform in size and shape, cellular, unusual? This list is not complete and will vary from material to material.

The ability to identify unknown materials on a morphological basis is directly proportional to the

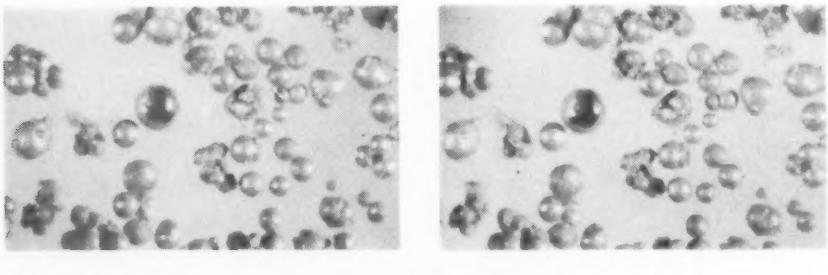

Fig. 3: *Two sets of stereoscopic photomicrographs. (Top: Dust from collector in steel rolling mill. Bottom: Cinders from dust collector on boiler burning West Virginia coal).*

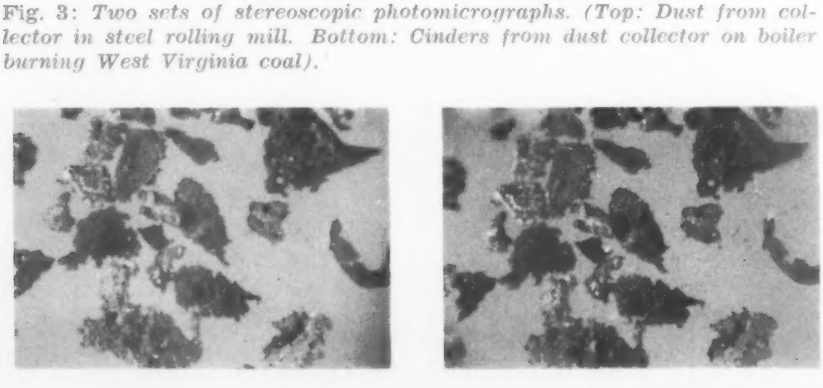

Fig. 4: A polarising microscope, suited for investigation of physical properties of particulate matter. A rotating stage permits proper orientation of a particle and measurement of crystal angles. Polarizer and analyser allow observation of particle in polarised light. Photo, Bausch & Lomb Optical Company.

number of known samples that have been observed by the individual microscopist and his ability to retain what he has seen. The greatest aid to the microscopist in this respect is a group of photomicrographs of known samples.

Photographs permit the observation of more known samples because they record exactly what was seen and retained in that image far better than the human mind. Photographs also allow the communication of observations since no word description is really adequate. This statement is illustrated by Fig. 5. This is a photomicrograph of diatomaceous earth, which is a classic example of a material which is easily identified by its morphology. It will be left to the reader to write a word picture which will adequately describe this material.

There is a great need for a catalog of photomicrographs of known airborne particulates in order that morphological methods of identification can be utilized to their fullest extent. Such work is in progress and will be of great value when completed.

The appearance of materials under the microscope can tell much more than just what the material is. It will give a great deal of information as to the history of the material and in many cases will permit tracing the source of the material. As one example, the flyash from an Alabama coal is much different from that of a Pennsylvania coal (see Figures 6a and 6b). Many other examples could be given.

A recently approved Public Health Service project provides for the formulation and assembly of a guide for the microscopic identification of particulate matter by the general procedure described above. The guide will take the form of a set of analytical techniques required and an atlas of photomicrographs in black and white, color, and stereo of known particulates.

One of the major problems is the securing of adequate representative samples of known history. *Any reader in a position to do so can render a great service to the authors and to the U. S. Public Health Service by sending samples, addressed to the authors, of particulate matter from specific sources which are, or may be, air pollutants.* A few grams, in a small vial or folded in a sheet of paper, together with a short identification and history will be sufficient. Credit will be given in publication of the atlas.

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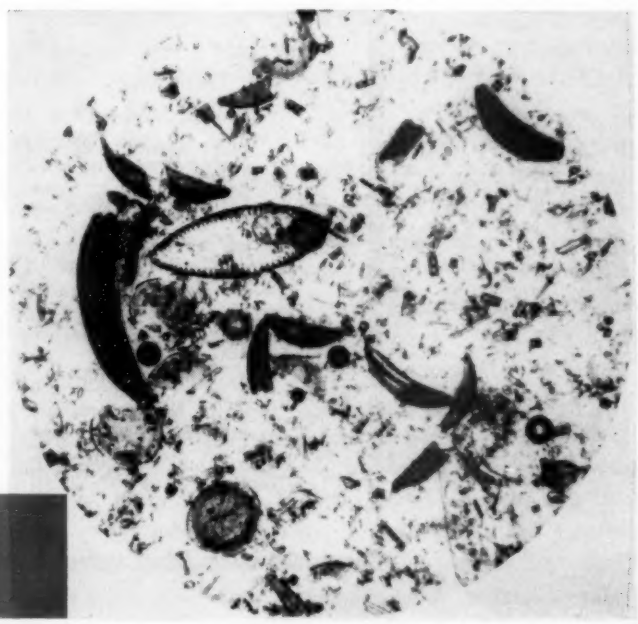

Fig. 5: Diatomaceous earth is largely the skeletons of microscopic sea animals. Here we see regular structure of diatoms, in a variety of shapes.

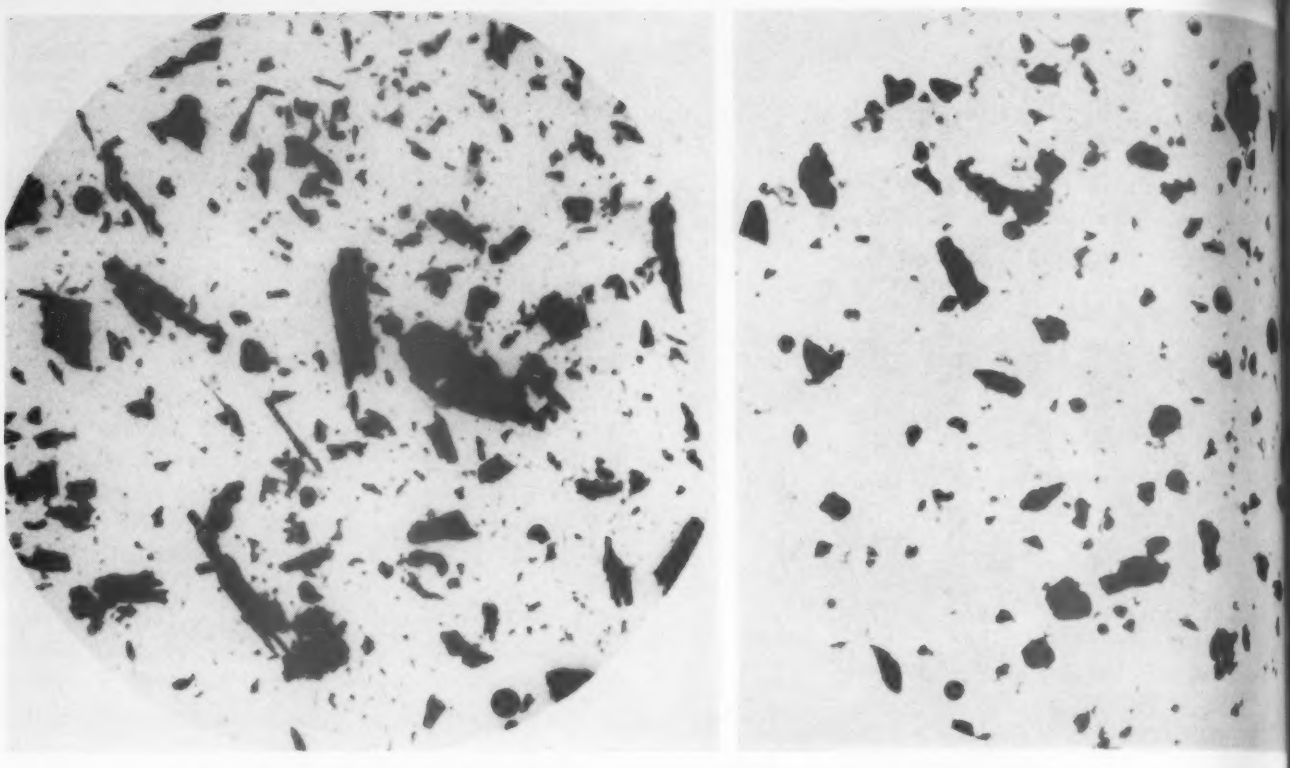

Fig. 6: *In photomicrograph on left, flyash from an Alabama coal is shown. At same magnification, photomicrograph on right illustrates a flyash from Pennsylvania. It should be noted that burning conditions are not the same for these samples of flyash.*

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The real value of the identification of dusts by morphology will soon be realized. The fundamental techniques are available to us; their application to air pollutants are now going to be applied in a comprehensive manner. It is hoped that this article, which merely scratches the surface, brings to the attention of the reader a simple, yet powerful tool that is available for the identification of particulate matter in air pollution. ▲▲

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Better Air for Industry

PART II

by Richard V. Sloan, *Senior Engineer*
American Air Filter Co.
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Fig. 1: *Fly ash removal from this boiler plant is accomplished by a dry centrifugal, multiple cyclone unit. 4 in. cones are banked.*

Part II of this series on the merits and shortcomings of air cleaning equipment takes up precipitators and the various types of fabric collectors and bag houses.

DUST COLLECTORS ARE CURRENTLY manufactured by 50 or more companies in the United States alone. Designs are varied, and often employ more than one of the known principles of separation of a solid, fume, mist or vapor from a gas stream.

Each year, a number of new designs are introduced, many of which find their application range after a shakedown period between the fond hopes of the inventor and the realities of the maze of factors that influence successful performance for varied problems encountered.

Most collectors can be grouped into one of the three following classes, namely: (1) high efficiency, high cost; (2) high efficiency, moderate cost; and (3) lower efficiency and lower cost designs.

Electrostatic Precipitators. The high voltage electrostatic precipitator is the predominant collector in this group. It should not be confused with the low voltage, small dust holding designs as used in air filtration.

The principle of collection relies on the ability to impart a negative charge to particles in the gas stream, causing them to move and adhere to grounded or positively charged collection plates.

Most precipitators are made for horizontal air flow with high velocities of 100 to 600 fpm. Collecting plates or electrodes are parallel elements, usually on 9-in. spaces, and constructed in various ways including corrugated or perforated plates or rod curtains.

Electrode rods are centered between the collector plates. Voltage difference between electrode and plate is 60,000 to 75,000 volts in most designs. Collector plates of cylindrical shapes surrounding the electrode rod are provided, where water is used to wash off collected material and where the gas stream is under high pressure or vacuum.

Electric precipitators have been extensively used in high temperature gas cleaning from equipment such as blast furnaces, open hearth furnaces, central station pulverized fuel boilers. The chemical industry has many applications, including sulfuric acid plants, carbon black, cement kilns, soda ash from paper mill black liquor furnaces. As voltage setting is close to the spark-over potential, application is limited to materials that are not explosive or combustible in nature, unless the carrier gas stream is an inert gas.

Sonic devices. In this same group can be placed recent efforts to use sound waves to agglomerate small particles into particle clumps of 5 to 15 microns, so lower cost collection equipment can be used to remove the materials. Power required to impart the necessary force to maintain required intensities in an air stream has retarded extensive use of this principal in present day air cleaning devices.

This group of collectors will include the fabric collector group and many wet type designs.

Fabric Collectors. Effectiveness of passing air or gas through a fabric at low velocity has been recognized and used for many years in air cleaning devices. Fabric is arranged in envelope or tubular (stocking) shapes (Fig. 2). While removal appears to take place by a straining action of the media, actually collection is obtained in arresters in this group by building up a mat of the material on dirty

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air side of the media, that provides the filtering or straining bed. By means of this bed, a high degree of removal is obtained even on sub micron size particles.

Where new fabric is placed in service, visible escapement will often occur during initial operation until build-up of the dust mat occurs.

As dust is collected on the fabric, resistance to air flow increases. Periodically (usually on 4 or 8-hour intervals) air flow must be stopped and the arrester reconditioned by rapping, shaking, or vibrating to agitate the fabric sufficiently to drop bulk of the adhering material to dust hopper.

Pressure drop after vibration will be considerably higher than loss through new clean fabric. Sufficient dust adheres to the fabric to maintain the dust mat needed for maximum efficiency. Unless the air flow is stopped, released material is re-entrained and considerable escapement also occurs through sealing devices used to hold fabric to its supports.

Rate of flow through media seldom exceeds 4 fpm and often is as low as 1 fpm. Ratings are usually selected so pressure drop will be in the 2-in. to 5-in. range between start and end of a cycle.

Resistance In Bag House

Smaller the particle, the more rapid the resistance rise for a given loading. For a given air flow rate and dust loading, resistance rise increases directly in proportion to time. Air flow is in the sinuous range, where resistance through fabric at any stage of loading will vary directly with change in air flow. Influence of higher air flow rates or longer intervals between vibration can be calculated from these relationships.

Fabric collectors are extensively used in industry for a wide range of applications. They require more space than most other types of air cleaning devices, which necessitate outdoor installation in most cases. Erection cost is high due to prevailing practice of completely knocked down construction when shipped by the manufacturer. Variation in air flow due to changing pressure losses is sometimes a disadvantage and the problem of dry dust removal often introduces a secondary dust condition.

Fabric collectors are limited to air conditions dry enough to prevent condensation or free moisture deposition on the fabric. With some materials, there will be a bonding tendency between particles and fabric under high relative humidity even though no condensation takes place. Maximum recommended temperature for cotton fabric is 180 F, for wool 200 F. Higher temperatures can be handled, but media replacement cost is considerably increased by using synthetic materials, including nylon and orlon fabrics as well as glass cloth and occasionally fine metallic mesh.

Continuous Duty Fabric Collectors. The disadvantages of stopping air flow to permit vibration, and variation in air flow can be overcome in several ways. Use of sectional arresters allows continuous operation of the exhaust system, as automatic dampers periodically take one section out of service for vibrating fabric while remaining sections handle the entire gas volume.

The larger the number of sections, the nearer the pressure loss will remain constant. Use of reverse air flow to increase effectiveness of removing adhering material is usually incorporated in such designs. Damper mechanisms are interlocked so inlets to outside are opened to allow a small amount of air to flow in reverse direction through the fabric.

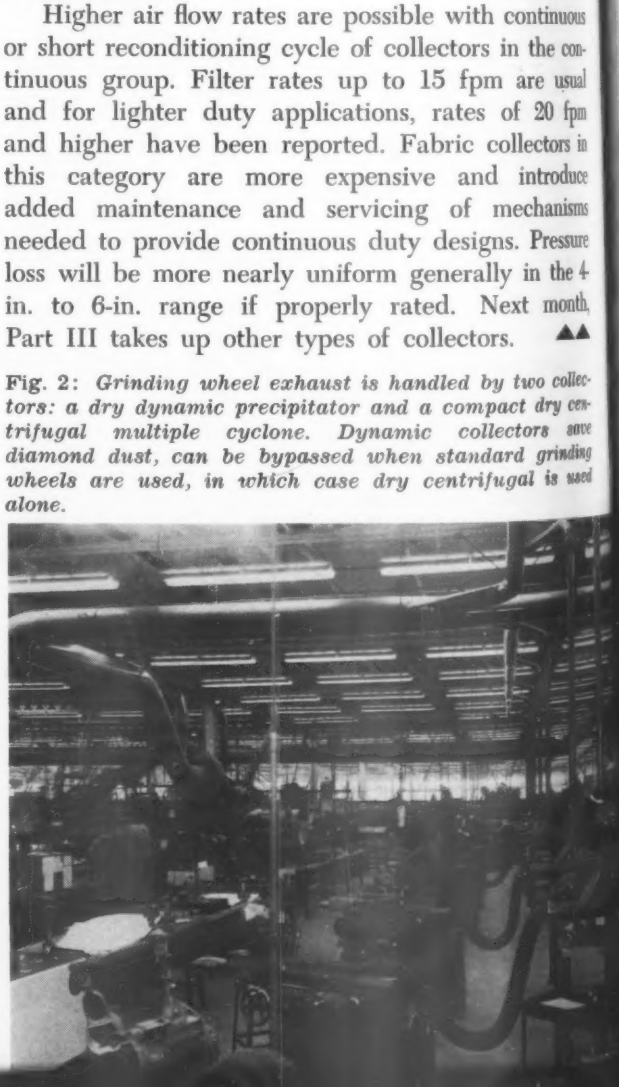
Mechanism does add equipment requiring additional attention and servicing due to difficulty of good damper sealing in a dust-laden air stream.

Reverse Jet Type of Continuous Arrester. This type arrester was developed in the United States several years ago and is currently being produced by several manufacturers. It differs from the conventional arrester in its use of high pressure air jets from a moving "blow ring," dislodging material from inside of the stocking shape of the fabric.

Cleaning or reconditioning by this method is more complete than that obtained by conventional vibration, making it necessary to use a thicker felted media to make up for the more complete removal of the dust mat.

Higher air flow rates are possible with continuous or short reconditioning cycle of collectors in the continuous group. Filter rates up to 15 fpm are usual and for lighter duty applications, rates of 20 fpm and higher have been reported. Fabric collectors in this category are more expensive and introduce added maintenance and servicing of mechanisms needed to provide continuous duty designs. Pressure loss will be more nearly uniform generally in the 4-in. to 6-in. range if properly rated. Next month, Part III takes up other types of collectors. ▲▲

Fig. 2: *Grinding wheel exhaust is handled by two collectors: a dry dynamic precipitator and a compact dry centrifugal multiple cyclone. Dynamic collectors save diamond dust, can be bypassed when standard grinding wheels are used, in which case dry centrifugal is used alone.*



Simplified Guide To Fan Selection

by C. O. Wood
Manager, Engineering Laboratory
Westinghouse Electric Corp.
Sturtevant Div.

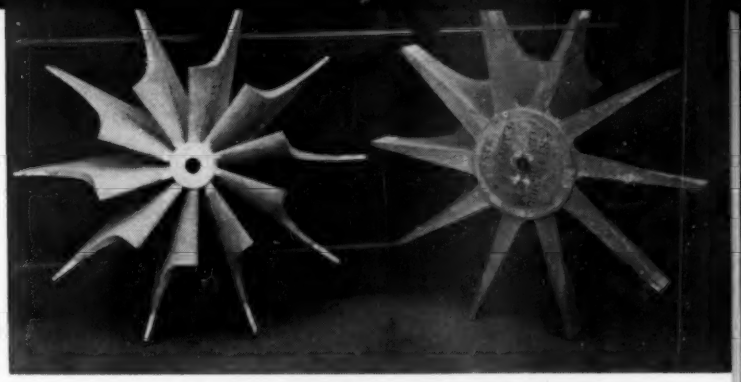


Fig. 1: *Heavy duty radial blade wheels. Radial blade elements produce excellent stress pattern for high temperature or high speed service.*

There's more to fan selection than tables, curves, charts, and graphs. Here are common sense guides to fan selection which go beyond tabular data and relate to noise, space, weight, air flow, efficiency, material handling, and parallel operation.

FAN APPLICATION can be confusing to the uninitiated. Over the years a number of names have been coined to describe fans as used in their various applications. Thus, we have blowers, exhausters, circulators, suction fans, pressure fans and so forth. These names seem to imply that a fan so tagged is usable only in the stated application. However, this is not the case.

A fan commonly used as a blower can also be used very well as an exhauster if it satisfies the requirements of the application.

Propeller and axial flow fans have come to be known as low pressure types. However, there are applications at higher pressures where these fans will suit the requirements better than a so-called pressure-type fan. For example, the space requirements of a job may permit a large diameter "pancake" shape of fan to greater advantage than the box shape of the centrifugal fan.

There are many factors which enter into a fan selection and the job application itself will indicate which are most important. Some of these factors are outlined below:

Noise: Most heating, ventilating, and air conditioning jobs will be critical for noise in more or less degree. Television and radio studios require very low noise levels whereas factory and restaurant installations will tolerate more noise.

The noise energy produced by a fan operating at peak efficiency is substantially dependent on the pressure developed. The higher the pressure, the more

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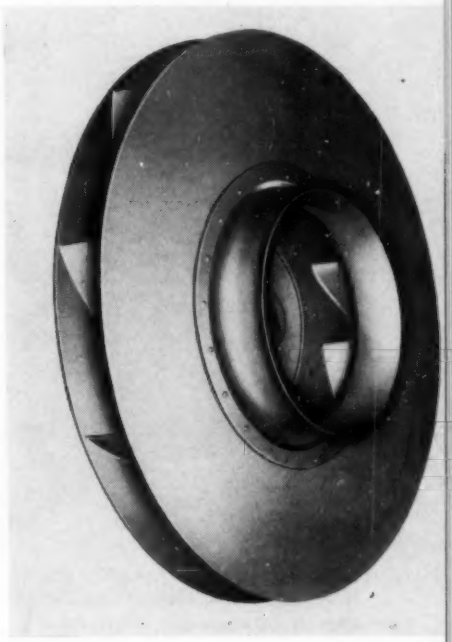

Fig. 2: *High pressure airfoil blade wheel designed for industrial use.*

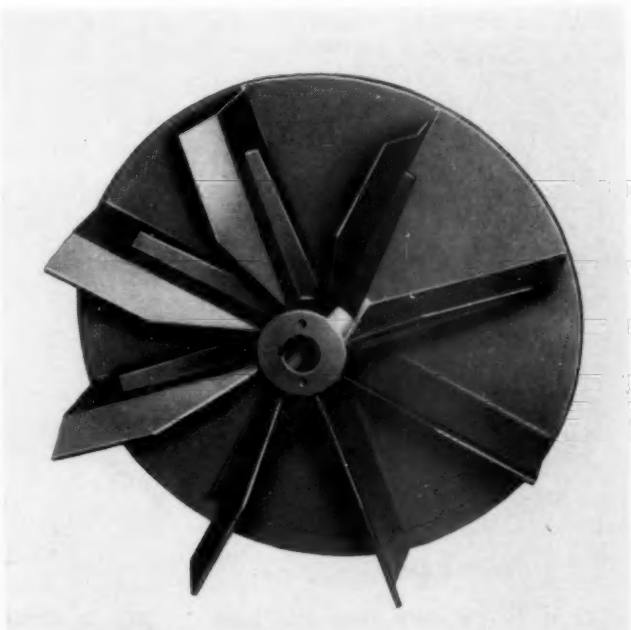

Fig. 3: *A material handling wheel for materials such as paper trim, glass fibers, etc.*

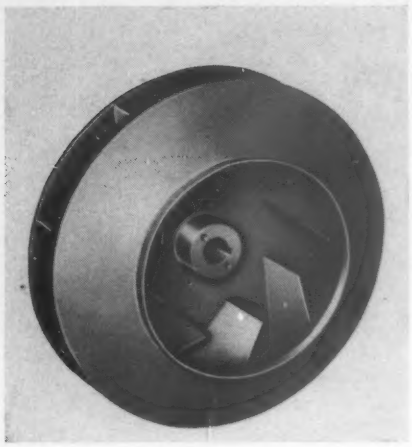

Fig. 4: *Industrial type wheel limited to relatively clean air (fumes or dust).*

Fig. 5: *Vaneaxial ventilation fan designed for shipboard use where compactness and high efficiency are essential.*

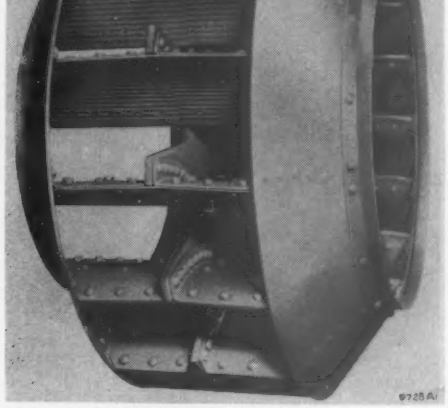

Fig. 6: *Heavy duty industrial type wheel able to stand up under severe erosion conditions. Ribbed plates are removable for easy maintenance.*

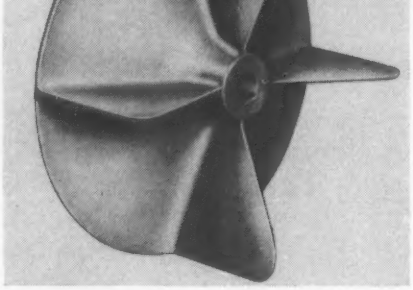

Fig. 7: *Radial blade wheel for air carrying wool fibers. Note absence of edges which would catch and hold fibers.*

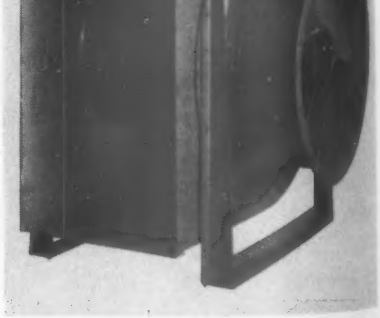

Fig. 8: *An elbow axial fan with bearings and motor out of the air stream.*

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noise will be created. Generally speaking, the different types of fans will produce nearly the same noise level when of comparable good design and operating at the same static pressure and air delivery. There are, however, differences in frequency characteristics and stability of the noise. Also well-designed airfoil fans will produce as much as five decibels lower noise level.

Forwardly-curved fans have a tendency to be unstable when operating near peak efficiency and this may produce an undesirable pulsating noise.

Axial flow fans have distinctive blade frequency noise which may be considered undesirable. The quality of this noise can often be improved, however, by proper fan selection. For example, a larger fan at lower speed often produces a more pleasing sound.

The space available for the fan is often a limiting factor. Forwardly-curved and axial fans are usually the most compact. An axial fan and its motor can be completely installed inside a straight length of duct in most cases.

Where weight is a consideration, axial fans have considerable advantage over the other types.

Fan efficiency is usually an important factor in any selection. This is particularly true of the larger fans and in locations where power cost is high. In this case, a comparison of the different fan types must be made at the operating point on the curve. The shape of the efficiency curve relative to the pressure curve is not the same for all types as can be seen by referring to Chart I. Forwardly-curved blading has an efficiency peak just to the left of peak pressure. Efficiency then drops steadily toward wide open.

The backwardly-inclined blading has a rather flat efficiency curve which holds up well out toward wide open. It is, therefore, essential that the efficiency at the point of operation be the criterion rather than peak efficiency.

The shape of the horsepower curve is another consideration which sometimes enters the selection

Chart I

Typical Fan Curves Illustrating the Difference Between Various Fan Types

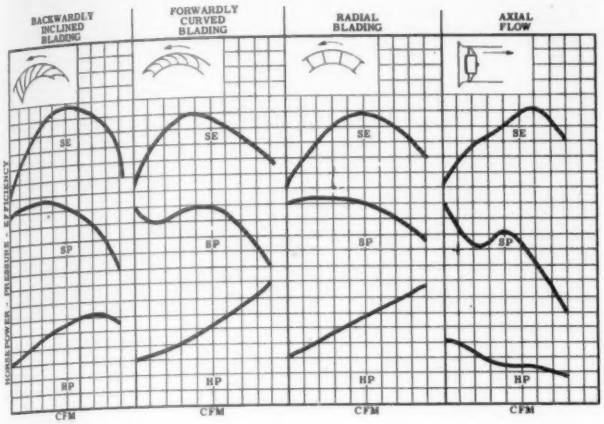
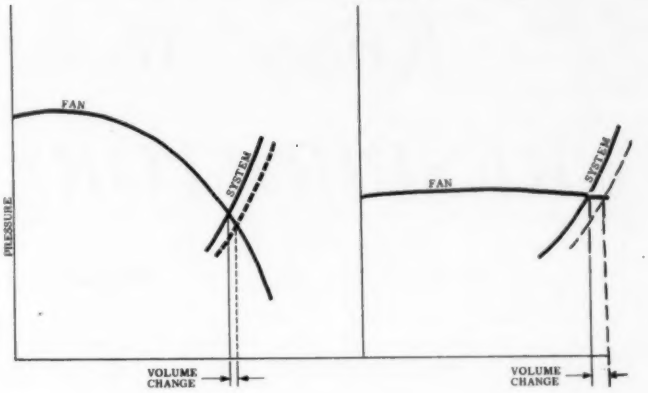


Chart II

Effect of Steep vs Horizontal Fan Curves on Volume Change Due to Change In System Resistance



picture. The horsepower curve for backwardly-inclined blading bends over at the peak and is referred to as a nonoverloading type. This characteristic will have a bearing on the motor selection, particularly if the exact system resistance is in doubt, if the volume varies widely due to demand, or if additional volume at the same or less pressure will be added in the future.

Vaneaxial fans have a relatively flat horsepower characteristic within the normal operating range. Propeller fans have a horsepower characteristic which slopes downward toward wide open—directly opposite to the centrifugal type. (The reader is referred to Chart I for these comparisons.)

Constant air flow: If a system requires a relatively constant air flow in spite of fluctuation in restriction, then consideration should be given both to type of fan and point of operation. Referring to Chart II, it is shown how a steep pressure curve produces a small change in volume when the restriction changes. Conversely, a horizontal curve produces a larger change in volume for the same change in restriction.

Materials handling: If the air contains stringy or sticky materials which may lodge in the fan, then consideration should be given to the radial-blade type which has self-cleaning characteristics.

The ability to operate in parallel may affect the choice of fan. The forwardly-curved centrifugal and the high pitch axial are the most sensitive in this respect. However, any design for paralleling fans should be carefully checked out to avoid trouble. (A later article in this series will describe the effect of parallel operation.)

Fans operated in series offer no particular problem, provided care is taken to prevent the spin leaving the first fan from affecting the second. The pressure developed will be somewhat more than double one fan due to higher density entering second fan.

The final criterion in fan selection is whether it will do the required job satisfactorily within the limitations of first cost and operating cost. Strict rules cannot be laid down to cover all applications. While it is true that the various fan types are segregated as to usage in a general way, each job must be assessed according to its requirements. The following chart compares the different fan types according to various application duties and can be used as a general guide to selection:

TABLE I—RELATIVE CHARACTERISTICS OF FANS

	Backwardly Inclined	Forwardly Curved	Radial Blade	Vane Axial
First Cost: Normal Duty	nearly equal			Low
First Cost: Heavy Duty	High	Low	Medium	Low
Efficiency	High	Medium	Medium	High
Stability of Operation	Good	Poor	Good	Poor
Space Required	Medium	Small	Medium	Small
Tip Speed	High	Low	Medium	High
Resistance to Abrasion	Medium	Poor	Good	Medium
Ability to Handle Sticky Materials	Medium	Poor	Good	Medium
Pressure Limitations	High	Medium	High	Low
Volume (CFM) Limitations	Medium	High	Low	High

What You Should Know About RESPIRATORS

PART I

If plant ventilation system fails and workers face lethal concentrations of toxic gases . . . if dusts are hard to control, you may need respirators. Here's the first of a series on industrial dusts, gases and vapors . . . and the respirators to protect against them.

by H. H. Fawcett*
Research Laboratory
General Electric Co.

Editor's Note: The protection of people against the toxic and hazardous effects of gases, mists, fumes and dusts has always been a subject well within the editorial scope of AIR ENGINEERING. *There are situations when the normal protective devices of ventilation systems, hoods over open vats or processes, exhaust air systems and the like, are not enough to protect the individual fully. Such cases call for respiratory devices of one type or another. This article presents a current review of the use of respiratory devices in industry, to help the plant engineer and safety engineer meet conditions within his plant calling for such protective devices.*

THE CLASSIFICATIONS OF THE HUNDREDS of toxic gases, mists, fumes and dusts found in industry are complicated. Selection of the proper respiratory device to protect against these substances therefore requires an acquaintance with these materials and with a wide range of respiratory devices.

This article is intended to give a basic knowledge of common industrial contaminants, their physiological effects and the type of respirator available to protect the wearer against these contaminants.

Mr. Fawcett is a Safety Engineer of broad experience with General Electric's Schenectady Laboratory.

Fig. 1: *Paint sprayer wears protective respirator hood, fitted with prefilter.* Photo, American Optical Company.

Most breathing air supply problems can be controlled with adequate ventilation. If air could be properly treated to remove particulate matter, noxious vapors, and toxic gases, heated or cooled, and then distributed as required, breathing can be reduced to a minor problem insofar as purity of air is concerned. Unfortunately, adequate ventilation and air treatment is sometimes impossible or impractical where emergency action must be taken to preserve life and property. Therefore, we must provide man with respiratory protection if we expect him to survive.

Classifications of Air Contaminants

Aerosols (dispersoids) (particulate contaminants): dusts, fumes and mists are basic classifications.

A better classification of aerosols is based on physiological effects:

Nuisance and Inert: produce no known injuries: calcium carbonate, magnesium carbonate, gypsum.

Fig. 2: *For protection against dusts, mists, radioactive particulate matter, and gases, this full face goggle and respirator is molded from flexible rubber.* Photo, American Optical Co.

Fig. 3: *For protection against non-toxic dusts and sprays, this filter can be worn with or without goggles.* Photo, General Scientific Equipment Co.

Aerosols may range in size from 150 microns to a thousandth of a micron in size (1 micron equals 39.37 millionths of an inch or 1 x 10^{-4} centimeter). Many dusts are also fire and explosive hazards.

Pneumonokonioses (Greek for lung dust) or pneumoconioses are a group of lung conditions which result from the inhalation of dust. Silicosis is one of the most common types of pneumoconiosis, and is caused by the inhalation of "free" or "uncombined" silica, such as quartz, opal, flint and crystobalite. Many other dusts may produce lung involvement such as asbestos, talc, silicates, and iron.

Other dusts cause chemical irritation, such as the acids, alkali substances, fluorides and chromates.

Allergic reactions may be caused by common dusts such as pollens, synthetic resins, plastics, felt, fur, gums, spices, tobacco, paper, rubber, wood, starch, flour, and wool. The Bureau of Mines groups all the above dusts as "Pneumoconiosis-Producing and Nuisance Dusts."

Inert pulmonary reactions: produce non-specific pulmonary reactions: silicates, carbon.

Minimal pulmonary fibrosis-producing: barium compounds, tin, iron oxides.

Extensive pulmonary fibrosis-producing: silica, asbestos.

Chemical irritants: produce inflammation or ulceration alkaline reactions: acids, fluorides, chromates.

Toxic systemic poisons: produce pathological reactions: lead, manganese, antimony, arsenic (not more toxic than Pb), arsenates, organic-phosphates, cadmium, radioactive, beryllium (more toxic than lead).

Allergic manifestations: produce allergic reactions: pollens.

Fever-producing reaction: action unknown or allergenic: metal fumes, certain textile dusts (hemp, cotton, jute, bagasse).

Aerosols (formerly called dispersoids or particulate contaminants) are substances which are present in the air as minute particles (such as dusts) as fumes (such as metal fumes), or as mists (such as chromic-acid mists). In grouping these together, it is recognized that they may be physically filtered, screened, or adsorbed from the air with properly designed filters.

Fig. 5: ***These filters are available with quickly interchangeable cartridges for protection against many specific dusts, vapors, gases and fumes. One basic respirator, with changeable filters, can cut inventory.*** Photo, American Optical Company.

Fig. 4: ***Entire area of mask is the filter. Mask is molded of one-piece plastic foam.*** Photo, Watchemoket Optical Co.

Another classification of dusts refers to *Toxic Dusts.* Some have a lower threshold limit or maximum allowable concentration than does lead, although the Bureau of Mines classification uses lead as a reference. In the toxic aerosol classification are: cadmium oxide fume, chromic acid and chromates, mercury, mercury (organic), yellow phosphorus, picric acid, selenium, tellurium, calcium arsenate.

(Please turn to following page)

Fig. 6: *Shakeout operation in foundry, showing worker wearing respirator for protection against dust.* Photo, American Optical Company.

Fig. 7: *Where a self-contained breathing apparatus of high portability is required, this unit can be used. Tank can contain either air or oxygen.* Photo, Mine Safety Appliances Co.

(Continued from preceding page)

Respirators approved for all the above dusts (both toxic and pneumoconiosis-producing and nuisance dusts) are called "dust" respirators.

A few substances, such as beryllium and radioactive substances, are not currently covered by Bureau of Mines schedules.

"Fumes" include aerosols formed by condensation of vapors from heated solids. Melting, cutting, and welding of zinc, lead, cadmium and other metals produce such fumes.

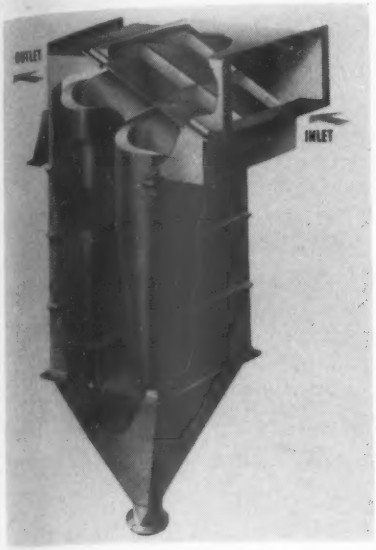
"Mists" and "Sprays" include liquid droplets formed when liquids are carried into the air or are formed by a reaction with the moisture in the air. An interesting example is 0.3 parts per million sulfur dioxide, which with sunlight, forms 20,000 particles per c.c. of sulfuric acid mist.

Respirators for insecticides are tested and listed by the U. S. Department of Agriculture.

Next month, gases, vapors and their effects will be discussed, and we will begin a detailed discussion of the various types of respiratory devices designed to protect against these substances. ▲▲

Fig. 8: *For fast action in an emergency, this "self-saver" respirator can be quickly popped into the mouth.* Photo, Mine Safety Appliances Co.

New PRODUCTS

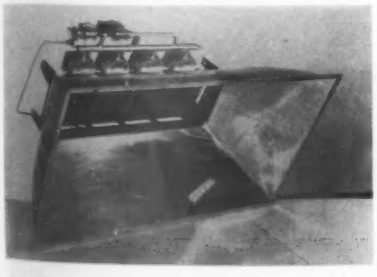


Cyclone Dust Collector

Purpose: For product recovery or dust elimination where ultra-high efficiencies are not required.

Features: Dustex 1600 dust collector has same patented design as Dustex Miniature Cyclone collector. However, tubes are larger diameter which reduces cost substantially while affecting efficiency only slightly. Cyclone tubes are mounted between inlet and outlet discharge tube sheets making possible an unobstructed inlet plenum.

Source: Dustex Corp., Dept. AE, P. O. Box 2520, Buffalo 5, N. Y.



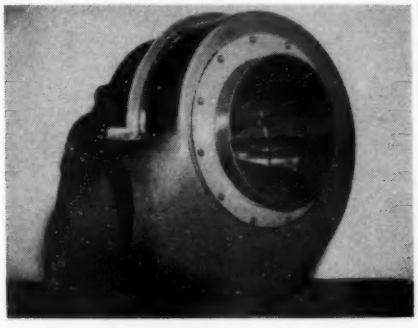
Gas-Fired Infra Red Heaters

Purpose: For heating high ceilinged buildings.

Features: Radiates infra-red rays which heat only the objects they strike. Rays are produced by burning a gas and air mixture on surface of a specially designed ceramic element. Ceramic surface glows at a temperature of 1600 F.

For general heating use, parabolic polished aluminum reflector can be mounted at heights to 45 ft. Straight side reflectors recommended on units mounted from 10 to 20 ft height. Heater outputs range from 12,000 to 48,000 Btuh.

Source: Perfection Industries, Div. of Hupp Corp., Dept. AE, 1135 Ivanhoe Road, Cleveland 10, Ohio.



Corrosion Resistant Blower

Purpose: For use where corrosive fumes or moisture are a problem. Adaptable to laboratory hood exhaust systems.

Features: Constructed of unplasticized rigid polyvinyl chloride that resists corrosion from almost all types and combinations of fumes. Available in ⅓, ¾, or 1 hp. motor and in capacities from 399 to 2,000 cfm. Equipped with rigid PVC housing and PVC multiblade wheel.

Source: Industrial Plastic Fabricators, Inc., Dept. AE, Endicott St., Norwood, Mass.

Demand Limiter for Electric Heat

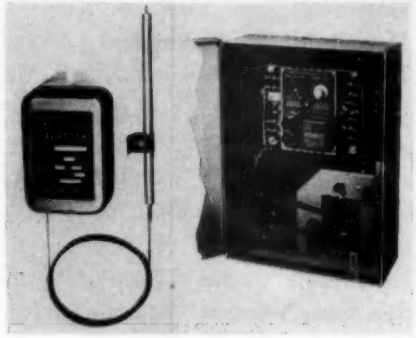
Purpose: Control power demand during warm-up period on electric unit ventilators.

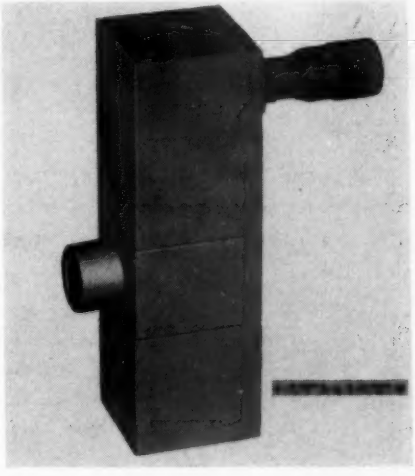
Features: Consists of outdoor adjuster and cabinet housing a proportional amplifier serving as a polarized relay and a proportional motor operator connected by a drive chain to a percentage cycling timer.

Wired in series with a zone warm-up thermostat, power demand limiter cycles electric heating equipment in an off-on manner until warm-up is accomplished.

Source: Barber-Colman Co., Dept. AE, 1300 Rock St., Rockford, Ill.

Use Communications Center, page 35, for requesting more information about articles, advertised products, literature, and for comments about any of the editorial material in this issue of AIR ENGINEERING.





Constant Volume Regulator

Purpose: For fully automatic regulation of controls where a constant volume output of gas or air is necessary regardless of fluctuating pressure drop.

Features: Capacity is controlled by micrometer adjustment. Output volume is from 5 to 180 scfh at pressure differentials from 1 to 25 psi.

Source: George W. Dahl Co., Inc., Dept. AE, 86 Tupelo St., Bristol, R. I.

(Please turn to following page)

New PRODUCTS

(Continued from preceding page)

Porcelainized Enamel Blower Wheels

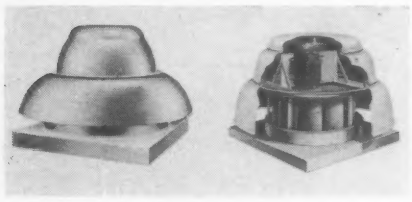
Purpose: For exceptional resistance to corrosion.

Features: Available in 10 to 20 in. sizes in capacities to 12,000 cfm.

Maintain same run-out and dynamic balance tolerances as standard wheels. Corresponding porcelainized housings and bearing brackets can also be supplied.

In salt spray test, porcelainized wheel showed no rust during first 120 hours, few rust spots after 168 hours, only minor traces after 1,000 hours.

Source: Morrison Products, Inc., Dept. AE, 16816 Waterloo Road, Cleveland 10, Ohio.



Low Profile Ventilator

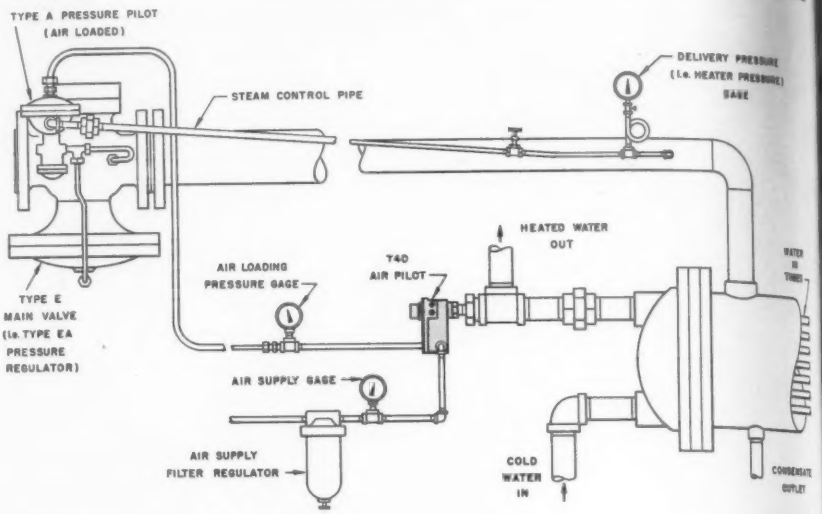
Purpose: Exhausting air from areas where roof mounting of a low contoured unit is considered desirable.

Features: Twenty-five basic selections of tip speeds and capacities in direct drive models and 64 basic belt drive models. Capacities range from 65 to 27,648 cfm. Horsepower ratings from 1/60 to 7½.

Heavy gauge spun aluminum housings with backward curved aluminum fan wheels. Motors and drives in separate compartments out of air stream. V-belt drive units have adjustable sheaves.

Source: Burt Mfg. Co., Dept. AE, 44 E. South St., Akron 11, Ohio.

Use Communications Center, page 35, for requesting more information about articles, advertised products, literature, etc.


TYPE A PRESSURE PILOT (AIR LOADED)
STEAM CONTROL PIPE
DELIVERY PRESSURE (i.e. HEATER PRESSURE) GAGE
HEATED WATER OUT
AIR LOADING PRESSURE GAGE
T40 AIR PILOT
TYPE E MAIN VALVE (i.e. TYPE EA PRESSURE REGULATOR)
AIR SUPPLY GAGE
AIR SUPPLY FILTER REGULATOR
COLD WATER IN
CONDENSATE OUTLET

Cascaded Air Control Of Temperature

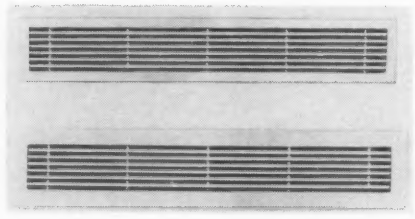
Purpose: Accurate temperature control for steam systems subjected to wide and sudden load swings.

Features: Cascading of an air signal to a pressure regulator produces a relatively inexpensive but highly accurate temperature control system – to 6 to 8 F over a 24 hour period under severe test conditions.

Quick response is based on bimetal temperature sensing element. Temperature pilot continuously regulates a loading air pressure. This loading signal when applied to a pressure pilot to reflect process temperatures causes it to reposition the main valve as changes in load require.

Only air required is that needed to produce a loading.

Source: Spence Engineering Co, Inc., Dept. AE, Walden, N. Y.



Extruded Aluminum Grille

Purpose: For supply and return installations.

Features: Curtainaire aluminum grille available in widths from 1½ in. to 15 in. in lengths up to 12 ft in one piece. Bars are obtainable in 0 to 15 degree settings with pencilproof spacing.

Two frame widths are standard with friction springs for floor or sill installation, safety catches for wall or ceiling installation.

Accessories include opposed blade damper, straightening vanes, and blanking baffles.

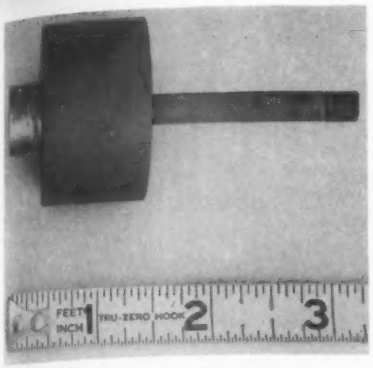
Source: Carnes Corp., Dept. AE, Verona, Wis.

Knitted Slip-Ons for Shoes

Purpose: Elimination of dust, lint, and other airborne pollution brought in on shoes.

Features: Washable, worn over street shoes. Made of special stretch nylon yarn so special sizes not needed. Yarn clings to dust particles, is lint free. Called Dus-Stop Laboratory Boot.

Source: Blue Star Knitting, Inc., Dept. AE, 1426-C North Farwell Ave., Milwaukee 2.



Heat Sink Liquid Level Detectors

Purpose: Measuring liquid levels of cryogenic fluids to .050 in.

Features: Weigh only 5 oz. Interject no energy or matter directly into the cryogenic medium. Are compatible with liquid oxygen, argon, fluorine, nitrogen, hydrogen.

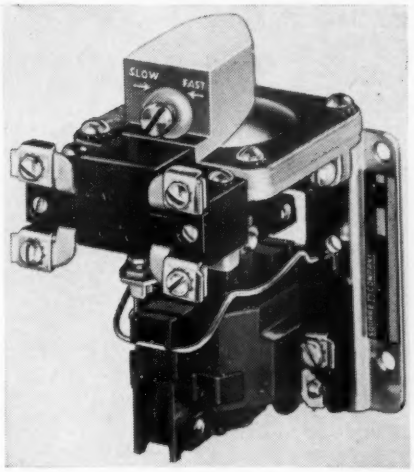
Source: Cryogenics, Inc., Dept. AE, P. O. Box 1919, Pompano Beach, Fla.

LP Gas Heater

Purpose: For temporary and spot heating.

Features: Produces 200,000 Btu and weighs only 45 lbs. Heat delivery end is a venturi tube which sucks cold air in from floor, mixes it with hot air from combustion chamber to give warm blast and protect floor from excessive heat. Main burner automatically extinguishes if power fails. Gas line automatically closes if pilot or main flame go out.

Source: Aeroil Products Co., Inc., Dept. AE, 69 Wesley St., South Hackensack, N. J.



Pneumatic Timer

Purpose: For use in dusty or dirty atmospheres.

Features: Has internally ported air system so no foreign matter can get in. Timing range adjustable from .2 seconds to 1 minute. Available for both a c and d c.

Source: Square D Co., Dept. AE, 4041 N. Richards St., Milwaukee.

Field Detector Kits

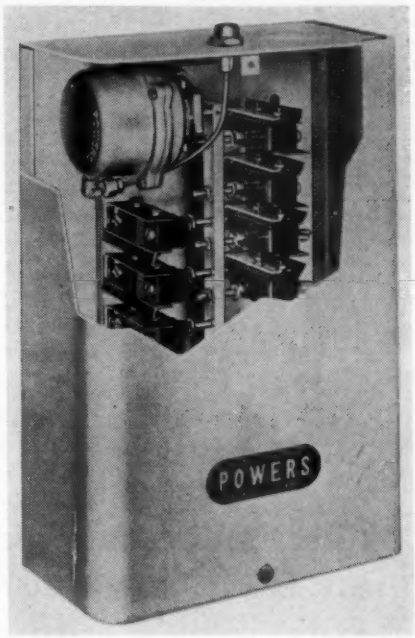
Purpose: To detect nitrogen dioxide, chlorine, or mercury vapor in air.

Features: All kits combine glass detector tube and bulb aspirator with a dozen tubes per kit. Sampling lines for remote locations are available in 10, 25, and 50 ft. lengths.

Nitrogen dioxide detector (shown) reveals concentrations as low as one-half part per million. Chlorine kit detects concentrations ranging from ½ to 20 ppm. Mercury vapor kit detects 0 to 1 milligram per cu. m.

Detectors are housed in leather carrying case.

Source: Mine Safety Appliances Co., Dept. AE, 201 N. Braddock Ave., Pittsburgh 8, Pa.



Pressure Electric Switch

Purpose: Provides step control of electric heat unit ventilators, fan systems, pumps, and refrigeration equipment.

Features: MS (Multi-Step) switch consists of a pneumatic motor which actuates a series of electric switches in response to a pneumatic signal. In this way, each heating element is energized in sequence in response to changing air signals passed by a pneumatic thermostat.

Normal supply pressure is 15 psi, maximum 25 psi. Switches rated at 20 amps at 125, 250, and 460 v.a.c., 1 hp at 115 v.a.c., and 2 hp at 230 v.a.c. Maximum ambient temperature is 160 F.

Source: Powers Regulator Co., Dept. AE, 3434 Oakton St., Skokie, Ill.

Memorial Auditorium, site of the Exposition, against the Dallas skyline.

Dallas Hosts Second Southwest Air Conditioning Exposition

While flavor is western, more than 200 exhibitors from 28 states make show of more than regional interest.

AIR ENGINEERS WILL FIND much to interest them at the Second Southwest Heating & Air Conditioning Exposition at Memorial Auditorium in Dallas Feb. 1-4.

The event will be staged under the auspices of the American Society of Heating, Refrigerating, and Air-Conditioning Engineers by the International Exposition Co., New York City. First Southwest Exposition was held in 1950.

The four-day exposition, open from noon to 10 p.m. Monday through Thursday, will show the engineer, architect, contractor, builder, building manager, owner, dealer, and distributor the latest available equipment in the air conditioning, air handling, ventilating, and heating fields.

All concerned with the purchase, installation, use, and sale of these products will be admitted to the exposition upon registration. The general public will not be admitted.

Of the 200-plus exhibitors – all space has been sold, according to the exposition management – more than 100 are expected to display industrial and commercial equipment of particular interest to the air engineer.

As a service to air engineers planning to attend the show, a *sampling* of exhibits that may be of particular interest to them begins on the next page.

This is merely a sampling. Space considerations and availability of data must necessarily limit it to that.

On page 50 appears a list of *additional* exhibitors (and their booth numbers) who are likely to show products air engineers would be interested in viewing. For your convenience, the list is arranged according to exhibit area.

Memorial Auditorium actually has three distinct exhibit areas. Just inside the main entrance on the second floor is the arena where booths 100 through 417 are located.

Downstairs on the first floor is a large circular area where booths 502 to 1029 are laid out. Adjacent to it is a rectangular area where booths 1100 to 1428 are set up.

AIR ENGINEERING will have a booth in this last named area – booth 1209.

Concurrently with the exposition, ASHRAE will stage its semi-annual meeting in the Brown and Adolphus hotels, only a few blocks from the audi-

torium. This will be the second national meeting of the consolidated society.

Here, too, the air engineer will find much to interest him. For instance:

On Tuesday morning, he could hear these three papers:

"Noise Reduction Characteristics of Package Attenuators for Air Conditioning Systems" by Norman Doelling of Bolt, Beranek, and Newman, Inc., Cambridge, Mass.

"Attenuation and Generation of Sound in Elbows with Turning Vanes" by William F. Kerka, research engineer, ASHRAE Research Laboratory, Cleveland.

"Draft Performance of Chimneys" by W. G. Brown and C. Wachmann, research officers, Div. of Building Research, National Research Council of Canada, Ottawa.

On Tuesday afternoon, ASHRAE will conduct forums on industrial ventilation, practical size limitation of air cooled condensers, and pipe and pick-up factors for boilers, among others.

The Wednesday morning program includes a symposium on the psychrometric chart and a paper on "Solar Heat Gain Factors for Windows with Drapes" by Necati Ozisik, research engineer, and L. F. Schutrum, research supervisor at the ASHRAE Research Laboratory.

Among the Thursday morning papers will be:

"Summer Weather Design Data" by H. C. S. Thom, chief climatologist, U. S. Weather Bureau, Washington, D. C.

"Environmental Study II – Evaluation of Human Comfort under Still Air Conditions" by Dr. Walter Koch, medical research supervisor, ASHRAE Research Laboratory.

"Proposed Humidity Standard" by C. E. Till, formerly with the Canadian National Research Council, and G. O. Handegord, Prairie Regional Station, Div. of Building Research, National Research Council, University of Saskatchewan, Saskatoon, Sask. ▲▲

What Some Manufacturers Will Show To Air Engineers

Acme Engineering & Mfg. Corp. **833**

Complete line of propeller type ventilating fans, belt and direct driven power roof ventilators, tubeaxial fans, and wall and ceiling shutters.

Aimco Products Corp. **728**

Air-cooled condensers 2 to 120 tons, air cooled condensing units 2 to 10 tons, featuring circular design with vertical air discharge and sloping tubes.

Air Devices, Inc. **1110**

AGITAIR air diffusers of square, rectangular, and circular design. Air diffusers with perforated face to simulate acoustical tile ceilings. Stripline slot type diffusers. Registers and grilles. High velocity units. Air and grease filters. Exhausters.

A-J Mfg. Co. **1100**

Registers, grilles, diffusers, convector grilles.

American Metal Mfg. Co. **405**

Helix Lockseam pipe and fittings for high velocity air conditioning.

American-Standard Industrial Div. **907, 911**

New package multi-zone air conditioning units, Kewanee package boiler units, Tonrac centrifugal refrigeration machine for air conditioning, Diaflo fan coil type room air conditioners for chilled or hot water, high pressure steam coils, utility sets, new Airfoil bladed fan, and air moving units for electronic and missile components.

Anemostat-Waterloo **102**

Anemostat air diffusers and Waterloo registers and grilles.

Baltimore Aircoil Co., Inc. **408-412**

First 100-ton blow-through evaporative condenser designed for indoor application. New line of cooling towers from 10 to 600 tons, evaporative condensers from 10 to 700 tons.

Cleaver-Brooks Co. **624**

Packaged gas fired heating boiler with burner and all required controls.

Cobell Industries, Inc. **806**

Remote air cooled and evaporative cooled condensing units, forced air furnaces, and evaporator coils.

Controls Co. of America **822**

A-P air conditioning and refrigeration valves, A-P gas control valves, and Redmond motors and blowers.

Curtis Mfg. Co., Refrigeration Div. **320**

Roof-type packaged air conditioners, packaged liquid chillers, 3-60 ton packaged air conditioners, 3-10 ton air cooled condensing units, and cooling towers.

Copeland Refrigeration Corp. **216**

Copelametic suction-cooled motor-compressors of 2 through 30 hp., Copelaweld welded hermetic 2 and 4 cylinder motor-compressors of ½ through 4 hp., and air cooled and water cooled condensing units.

Drayer-Hanson, Div. of National-U. S. Radiator Corp. **1129**

New hot and cold deck high pressure air handling unit, 30-ton air cooled condenser, and a fully operative air conditioning system in miniature including control panel, evaporative condenser with desuperheat coil, blower-fan-filter assembly, and grille outlet.

(Please turn to following page)

(Continued from preceding page)

Dunham-Bush, Inc. 203-209
New multi-drive compressors, new air handling units, new low silhouette blower condensers, new roof top air conditioners, new recessed year round air conditioners.

Econo Products Co., Inc. 606
Motorized dampers and controls for automatic zoned heating and cooling.

Farr Co. 829
New automatic traveling curtain filter, new manually operated and high efficiency disposable media filters.

John Felter Co. 701
Aspirating type ventilator, remote heat pump that removes frost on exterior coils as quickly as it forms without reversing cycle or adding electrical energy.

Flanders Filters, Inc. 1425
Airpure absolute-type filters, supply air purification units for chemical, bacteriological, and radiological removal.

Flexible Tubing Corp. 305
Thermaflex air conditioning ducts for high and low pressure systems.

Greenheck Fan & Ventilator Corp. 1116
Power roof and sidewall exhausters.

Halstead & Mitchell 926
Vertical discharge air cooled condenser, air handling unit.

Janitrol Heating & Air Conditioning, Div. of Midland-Ross Corp. 714
School heating, ventilating, and cooling systems, and unit heaters.

Jenn Air Products Co., Inc. 623
Spun aluminum direct drive wall and roof exhausters with U-spring suspension.

Joiner-Meade-Capers, Inc. 835-839
New Breidert gravity Air-X-Hausters, Ajax packaged hot water boiler, Continental manual and automatic roll filters, Electro-Air electronic air cleaners, and Korfund isolation materials.

Morrison Products, Inc. 615
Vent sets for commercial and industrial use, porcelainized blower wheel and assemblies, and Vari-Air damper control for air-cooled condensers.

Muellermist Irrigation Co., Fanjet Roof Cooling Div. 310
Roof cooling system.

More Exhibitors Who Will Show Items for Air Engineers

In the Arena—2nd Floor Booths 100-417

Alton Mfg. Co. 403
Ammerman Co., Inc. 221
Automatic Devices, Inc. 101
Bell & Gossett Co. 416
Carnes Corp. 208
Chattanooga Royal Co. 409-15
Loren Cook Co. 103
Edwards Engineering Corp. 109
Fluor Products Co. 300
Henry Valve Co. 312-14
Jackes-Evans Mfg. Co. 307
Johns-Manville Sales Corp. 402
Johnson Service Co. 108, 112, 116
McQuay, Inc. 212
Mine Safety Appliances Co. 302
C. A. Olsen Mfg. Co. 217
Randall Graphite Bearings 304-06
Schnacke, Inc. 308
Torrington Mfg. Co. 303
U. S. Register Co. 316
Viking Air Products Div., National-U. S. Radiator Corp. 311

In the Round—1st Floor Booths 502-1029

Acme Industries, Inc. 515, 521, 523
American Air Filter Co., Inc. 524, 628, 629
American Gas Association 1005
Arkla Air Conditioning Corp. 910
Armstrong Cork Co., Insulation Div. 720
Barber-Colman Co. 705-07
Bryant Mfg. Co. 1011
Carrier Corp. 1010, 1014, 1020
Chrysler Corp., Airtemp Div. 620-22, 723
Day & Night Mfg. Co. 502, 601
Detroit Controls Div., American-Standard 805
Furnas Electric Co. 722
General Controls Co. 904
E. D. Goodfellow, Inc. 611
Gustin-Bacon Mfg. Co. 600
Hart & Cooley Mfg. Co. 1023
Ilg Electric Ventilating Co. 920-22
Industrial Combustion, Inc. 802
International Mfg. Co. 828
Marley Co. 814
Marlo Coil Co. 700
Minneapolis-Honeywell Regulator Co. 1024, 1029
Mueller Climatrol 921-23
Owens-Corning Fiberglas Corp. 821
Payne Co. 903
Perfection Industries, Div. of Hupp Corp. 901
Raypak Co., Inc. 824
Ready Power Co. 1007
Research Products Corp. 803
Rheem Mfg. Co. 915
Ridge Tool Co. 1004
A. O. Smith Corp. 610
Sporlan Valve Co. 1001
Texas Products Mfg. Co. 607
Trane Co. 505-07, 511
United States Air Conditioning Corp. 905
Vibration Mountings, Inc. 506
Westinghouse Electric Corp. 514, 825
Worthington Corp. 925, 929

In the Square—1st Floor Booths 1100-1428

Air Conditioning, Heating & Refrigeration News 1312
Air Conditioning Industries, Inc. 1223
Air Con Filter Co. 1404
Air Engineering 1209
Auto-Flo Corp. 1409
Chicago Blower Corp. 1124, 1225
Dryomatic Corp. 1118
Eggelhof Engineers, Inc. 1224
Illinois Testing Laboratories 1216-12
Industrial Acoustics Co., Inc. 1323
KSM Products, Inc. 1208
Lima Register Co. 1309
Metal Mfg. Co. 1111
Milwaukee Electric Tool Corp. 1114
Phil Rich Fan Mfg. Co., Inc. 1204
Pyle-National Co., Multi-Vent Div. 1121
Sprague Electric Co. 1129
Texas Refrigeration & Engineering Co. 1211
Thermo-Pak Boilers, Inc. 1108
Trion, Inc. 1112
Tubenfin Coil Co., Inc. 1215-17
H. W. Tuttle & Co. 1401
Venteo, Inc. 1204
Warren Register & Grille, Inc. 1107
Western Supply Co. 1214-16
White-Rodgers Co. 1308
L. J. Wing Mfg. Co. 1218-20

Norman Products Co. 900
Schoolroom heating and ventilating system utilizing book shelving cabinets for air distribution.

Peerless Mfg. Div., Dover Corp. 1015
Expanded line of Peerless Uni-Matic unit heaters to 300,000 Btu and redesigned recessed wall furnace with top-to-bottom louvered design.

Penn Controls, Inc. 724
Air conditioning controls.

Recold Corp. 119-120
Small, compact horizontal air handling unit; high pressure heating, ventilating, and air conditioning unit for static pressures up to 6 in.; and air cooled condenser with vertical discharge.

Reed Unit Fans, Inc. 1025
Contr-Rotating fan with two blades revolving in opposite directions in same tubeaxial housing. Propeller type roof ventilator in mushroom housing, belt driven tubeaxial fan, belt driven commercial exhaust fan, grain drying fan.

H. H. Robertson Co. 704
Q-Air floor that replaces branch duct portion of all-air, high velocity air conditioning system by distributing air through cellular floors over beams.

Schemenauer Mfg. Co. 1424-1428
Classroom heating and ventilating units with bookshelves as matching components for unit ventilators. Acousti-Vent auditorium unit ventilator.

Stoddard Industries, Inc. 1408
Dust-magnet electrostatic permanent air filters.

Texas Infra Red Radiant Co., Inc. 1101
Schwank perfection infra red gas heaters and Sogena fireless gas heaters.

Utility Fan Corp. 711
Centrifugal air handling equipment, Class I through Class IV. Electrodynamic balancing techniques.

Vilter Mfg. Co. 1105
100-ton packaged water chilling unit including compressor, flooded shell and tube chiller, shell and tube condenser, and 100 hp motor in one self-contained unit.

L. R. Ward Co. 1115-1117
Full line of Chromalox electric heaters and controls for industrial, commercial, and residential uses.

York Corp. 706, 710, 807, 811
Central station fan coil air conditioning, lithium bromide absorption water chilling systems, packaged water chillers, three-pipe Hi-I induction air conditioners, air source heat pumps, hermetic Turbopak, and air and water cooled commercial air conditioners.

got a **SPRAY NOZZLE** *problem?*

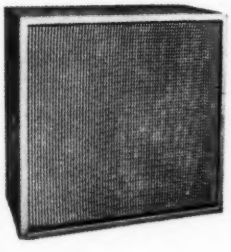
perhaps one of our **DATA SHEETS** *can suggest a solution*

For almost every spraying application, there's a Spraying Systems Data Sheet that gives useful information on suggested installations and types of nozzles to use. If you have a problem, write and let us know the application involved . . . and we'll send the Data Sheet that applies.

SPRAYING SYSTEMS CO.
3202 RANDOLPH STREET • BELLWOOD, ILLINOIS

And . . . for complete spray nozzle information, write for Catalog 24.

COMPLETE FILTRATION FOR SUB MICRON PARTICLES



Flanders **AIRPURE** Absolute Filters

Airpure absolute Filters combine the greatest dust holding capacity with the lowest resistance factor.

- 15% more filter medium, catches more particles
- Filter medium has no binder to clog pores
- Filter medium has low initial P.D.

Rate it either way: 1000 CFM @ .75" W.G.
1300 CFM @ 1.00" W.G.

Many models available for a wide variety of applications.

Gas vs. Electricity

(Continued from page 22)

substantially the same as Michigan Consolidated Gas Co. (Flint) and degree days and heat loss for the two buildings are within two percent.

Electricity for circulating pumps and gas burner amounts to: Total 5 hp or 5 kw x .20¢ = $200/yr.

Space Requirements

According to the consulting engineer, electric heat does not eliminate a boiler room per se, it merely eliminates space occupied by a boiler and auxiliary equipment such as pumps.

The space required for an incinerator, water heater, water tank, water treatment equipment if needed, electrical distribution center, and similar mechanical equipment, is the same or nearly the same as for a conventional boiler room.

Conclusion

On the basis of first cost and operating cost, the consulting engineer recommended to the School Board that a gas-fired heating system be installed. The Board then voted to have such a system installed.

The consulting engineer also pointed out that electricity was not an easy medium to modulate, and that it would not allow low cost tempering of outside air needed for ventilation, due to high heating cost per Btu.

In future issues we will present the case for electricity in commercial, institutional, and industrial buildings, as a heating medium.

There is much to be said for electrical heating, both from an economic standpoint and from a technical standpoint. Some of the newer electrical heating techniques bear investigation and explanation, and some of the latest developments in electrical heating equipment offer great promise.

As forthright application engineers for electrical utilities have stated, there are some buildings, regardless of electrical rates, which simply do not lend themselves to electric heating. And by the same token, there are buildings, even in areas of relatively high electrical rates, where electrical heating can be ideally applied and can be competitive with any other form of heating both as to costs and heating results.

In addition to presenting the case for electricity, we also plan to give comparative data on gas and electricity based on studies soon to be released by qualified engineers. ▲▲

AIA Endorses Retained Percentage Formula

Board of Directors of American Institute of Architects has endorsed a retained percentage formula. At a meeting in Portland, Ore., the board passed the following resolution: "Resolved, that the board herewith endorse recommendation that architects give serious consideration to the adoption of the policy of retaining a maximum of 10 percent of the certified contract price until 50 percent of the work has been completed, at which time no further retainage would be exacted, if the architect is satisfied with the performance of the contractor."

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